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Engineering News-Record

Curing a Concrete Road in Maricopa County, Near Phoenix, Arizona

Articles In This Issue: **Building 309 Miles of Concrete Road in Maricopa County, Arizona—Planning for a 3240-Foot Suspension Bridge at New York—Labor Hours in Construction as a Basis for Valuation—A Concrete Sea Wall for a Power House**

KREOLITE LUG WOOD BLOCKS

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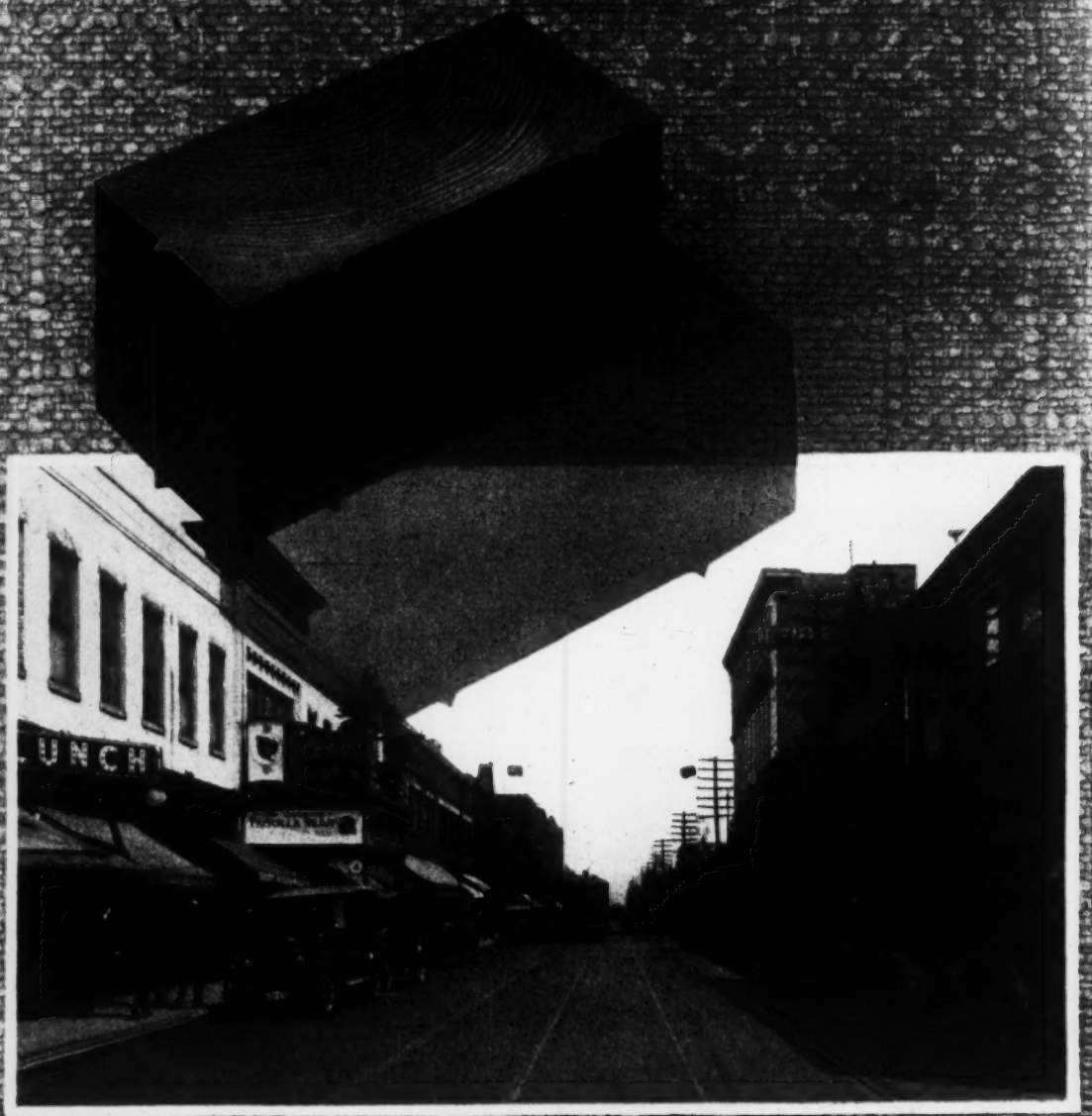

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 86 — NEW YORK, MAY 26, 1921 — Number 21

Hudson Tunnel Engineers

OBJECTION has been made that the juxtaposition of a news article and an editorial note in *Engineering News-Record* for May 12 has cast reflection on three well-known New York engineers, George M. Wells, St. John Clarke, and Col. George L. Watson. The news note recorded the facts of the discharge by the New Jersey Interstate Bridge and Tunnel Commission of the board of consulting engineers employed jointly by it and by the corresponding New York commission, and the appointment by the New Jersey commission of the gentlemen above named as its consulting engineers. The editorial note gave emphatically this journal's views regarding the action of the commission. A reading of the editorial should in itself be convincing that the personality of the New Jersey commission's appointees was not even considered, but lest there be misunderstanding, *Engineering News-Record* desires to make it clear that its strictures applied to the action of the commission alone and was not meant to reflect on the engineers in question.

A Record County Road Program

MARICOPA County, Ariz., has leaped into fame among highway engineers because it let a contract for 141 miles of concrete road to a single contractor. No less notable is the entire plan, of which the first contract is only a part, involving 309 miles of paved roads in this garden country, not long ago given over to sand wastes, sage brush, and picturesque tall cactus. With an area of 8,891 sq.mi. it required the courage typical of our Far West to resolve to place every farm house in the valley within one mile of a paved highway. Eastern counties with their greater conservatism would have figured much longer and would undoubtedly have concluded to spread the work over a great many more years than called for in the Maricopa plan. The contractor's performance seems to keep pace with the boldness of the county's project, for an article in this issue tells about completing 3,000 ft. of highway per day, with five paving mixers in operation. It is true that a job of such size requires vigorous handling, but that fact does not detract from the credit that belongs to an organization which is putting the job through. Naturally in a project of this magnitude the general construction plan is of great interest. For that reason the article in this issue covers in a general way the plant and procedure adopted by the contractors. Later articles will give details that are of special interest.

Thickening Pavement Edges

EDGE BREAKAGE is being rather purposefully studied in recent designs for concrete roads. For the Maricopa County, Ariz., road system, the concrete slab, as shown on page 883, is thickened from a line 2 ft. back on each side, to the edges, the increase all being on the bottom of the slab. Recent pavements in Oakland, Cal., are built with inverted curbs, 6 x 12 in., reinforced at the bottom. In Illinois another design for the same purpose has been worked out as described in *Engineering News-Record* March 24, 1921, p. 504. Half a dozen localities report pavement failure due to the progressive breaking down of the edges of the slab by heavy trucks, and the opinion is expressed that something has to be done immediately to reinforce the strength of pavement edges or failures will be repeated. The change of thought is quite radical from a few years ago when engineers were speculating whether all purposes would not be as well served and concrete saved, by making the slab 3 or 4 in. thinner at the edges than at the center instead of 1 or 2 in. thinner as was the common practice.

Missing an Opportunity

AT ITS coming meeting in Chicago the American Society of Mechanical Engineers will have a session devoted to construction machinery. While, obviously, the design of such machinery might be considered within the scope of the mechanical engineer, its function is the business of the civil engineer and of his co-worker —the contractor. While no one can quarrel with the mechanical engineers in scheduling this subject for discussion, the incident serves to recall the sweeping neglect of construction by the American Society of Civil Engineers. In that field lies a large opportunity. What the engineer designs is of no value until it has been embodied in steel, in masonry, in wood, or in the other materials of engineering. The cost of putting these things together to produce the finished structure is largely determined by the type and efficiency of construction machinery. The design and development of such machinery, therefore, are nearly as vital to the civil engineer as are the methods and theories of design; all the more reason why the American Society of Civil Engineers should not neglect the subject. The opportunity is a great one and should have the consideration of the officers of the society in this day of revival of technical activity and interest.

Unified Terminal Operation

LAST WEEK these columns raised the question of effecting substantial economies in railroad operation through the application of exact, scientific methods to operating problems heretofore solved largely by rule of thumb. Emphasis was laid on the matter of freight-handling methods and terminal operation. The article in this issue, abstracting a recent paper of George H. Kimball on the terminal problem, points strikingly to possibilities of economy not only by better methods within single organizations, but by co-operative methods between different companies and the elimination of wasteful competitive practices. Briefly, Mr. Kimball maintains that unified operation of the terminal proper-

ties within a city is essential to economy. The directness of his argument suggests not only possibilities of consolidating railroad properties under the Transportation Act, but raises the broader question of how far the terminal business—between the outer classification yard and the shipper's door—should be separated from the line-haul business.

A Chance for the Critical

UNDER date of May 16 and with the postmark of one of our leading technical colleges a letter has reached this office. It contains the following reasonable request: "I understand that you have published an article on the design and construction of a concrete shipway. If you have such an article I would appreciate it very much if you would send me one as soon as possible. I have this subject for a graduating thesis in June, and as I have only a short time in which to work would appreciate a prompt reply." Aside from the fact that the allotted time seems distressingly short for the adequate preparation of a graduating thesis, there is little here that can be used to point a pedagogical moral. The critics of our educational system, though, are entitled to this one fact—the letter is not signed.

A Question of Communication

SO MANY problems meet in the Hudson River crossing question that a discussion such as was had before the New York section of the American Society of Civil Engineers last week inevitably brings forth a wide divergence of view. Technical details of the question, each constituting the immediate difficulty according to the individual standpoint, received main attention. It is true that all of these "details" are formidable engineering problems by themselves. Yet the isolation of New York island from the mainland, and therewith its physical separation from half its potential area of supply and influence, remains the major characteristic of the situation. That this stays in the background in a discussion of the kind referred to is the more easily understood when the effect of the intervening state-line on the relations between the two banks of the Hudson is taken into account. As time goes on, however, the political separation of the territory as well as the complication of the broad question by its difficult component problems are likely to prove less influential, and the essential demands of communication will receive more consideration. As has been urged time and again in these columns, adequate highway connection of New York with the rest of the country is vital to the efficiency of the nation's greatest commercial center, and hence also to the nation's own commercial efficiency.

Time Costs of Building Work

A NOTABLE contribution to the literature of cost data will be found on p. 888 of this issue. Frank E. Barnes, supervising building valuation engineer of the New York Central Lines, presents a great volume of experience regarding the time required for building construction operations. As indicated in the explanation in his article, the values have been determined with exceptional care. This is the important characteristic of these tables contrasted with similar schedules of time costs. They represent the consensus of opinion of many contractors, obtained during months of study of the subject in connection with the federal railroad valuation. The author was fortunately able to secure independent statements from reliable contractors regarding their cost experiences. Although developed primarily to determine the reproduction cost of existing buildings, the values given are equally useful for estimating the cost of new construction. The tables, therefore, serve not only the appraisal engineer, but building engineers and contractors as well. The values stated, like all other figures intended to define quantitatively the productiveness of labor, must be employed with good judgment. The author, an experienced contractor as well as an appraisal engineer, emphasizes this fact in his comment. In these days of uncertain efficiency of construction labor a reassertion of the warning is not out of place. Used wisely, the time cost schedules on p. 888 are of very great value.

Subgrades Under Suspicion

DECREASING confidence in subgrades has been a striking development of highway engineering thought during the past two years. Formerly, so long as the road was fairly well ditched and the pavement slab distributed the load fairly well, little fear of subgrade weakness was expressed. Disturbances due to freezing and heaving were always feared, but the supporting power, in general, of normally sound subgrade caused little concern. Now no detail of a paved road structure is more under suspicion. Indeed the capacity of subgrade for destruction has come to be spoken of almost tremulously. Two reasons appear. One is the report of paved roads breaking down under heavy truck traffic because of subgrade weakness. The second is laboratory evidence of moisture action on soil stability and the capacity of capillarity to develop a dangerous moisture content in soils. While enough facts of both sorts have been disclosed to warrant their careful appraisal and further investigation, the big fact remains that the mileage of pavement which has failed is a very small fraction of the total mileage and on the whole our paved roads have stood up well.

Department of Commerce Appropriations

ECONOMY in operating our federal government—and all governments for that matter—needs now to be preached in season and out. *Engineering News-Record* has consistently done so since the close of the war. It would seem to run counter to this policy to advocate additional appropriations. Yet the deficiency appropriations asked for by the Secretary of Commerce seem to promise such excellent returns to the industry of the country that we urge upon our readers their sympathetic consideration of these requests. If their views accord with ours, they should as citizens express their views to their representatives in both House and Senate. The House committee has already acted favorably upon the request, while in the Senate the bill is still in committee.

Briefly, Mr. Hoover has asked for deficiency appropriations totaling $618,000. This seems very modest, even when added to the $8,800,000 already appropriated, particularly when the amounts carried by the pending Army and Navy bills are considered. Of the additional appropriations asked for, $250,000 is for the promotion of foreign commerce, and an equal amount for broadening the work of the Bureau of Standards.

Of the need for intelligent promotion of our foreign trade there need be no demonstration to thinking Amer-

icans. Few subjects of national import have had so much attention since 1914. Mr. Hoover's plans for the use of this money contemplate an intensification of the present news gathering and distributing services pertinent to foreign commerce.

Of the requested appropriation for the Bureau of Standards, $50,000 is for additional work in the testing of structural materials; $100,000 for industrial research, looking to the elimination of waste in industry, and $100,000 for studies in standardization of equipment. The last-named studies have in view the establishment of manufacturing and commercial standards of machinery, equipment and devices, including such matters as the elimination of unnecessary forms, varieties and qualities. The structural materials studies would be directly largely toward securing information pertinent to the present housing shortage.

All of the objects so commend themselves to engineers and contractors that fuller discussion is unnecessary. Mere personal approval, though, is of no practical value. We must indicate to Congress that, even in these days of the need for urgent economy, we endorse these additional appropriations, confident that they will be a profitable investment and not an unproductive expense.

The A. A. E. Convention

THE present condition of the American Association of Engineers has been likened to that of a machine which has passed through the period of initial wear and is undergoing readjustment. This was apparent in the convention at Buffalo last week. With 7,000 names added to the organization's roster during the past year, bringing the total to about 25,000, it was to be expected that the mechanism for carrying on this year's activities would need attention, and the greater part of the time of the convention was devoted to a revision of the constitution and to a discussion of chapter activities.

Some of the older members of the conservative founder societies have thought of the American Association of Engineers principally in terms of an organized effort to secure increased salaries for its members. At the Buffalo convention this subject was decidedly in the background. It cropped out once or twice in connection with the report of the committee on standards of practice and fees for consulting engineers and in statements of what the railroad section had accomplished in securing increased compensation, but, by and large, compensation figured little in the discussions.

The meeting developed no matters relating to the constructive work of the association. The new administration will, in all probability, devote its principal effort to the strengthening of the local chapters, although no definite program was announced. The prediction is based upon the approval given to the increased allotment—60 per cent—of incoming funds to the chapters and the consequent curtailment of money available for headquarters, involving also the elimination of the district offices at New York and Washington and the suspension of the work of the director of field forces. Local autonomy also will be strengthened by the new scheme of districting and the election of directors by votes from the district they represent.

As far as the association's constructive work is concerned, therefore, the Buffalo convention made no contribution. Its sole accomplishment lay in the development of its internal mechanism.

An Important Experiment in Society Management

BRIEF comment was made in these columns last week upon the incorporation by the American Association of Engineers in its by-laws of the arrangement, already in partial effect through the directors' action, of allocating to the chapters 60 per cent of all initiation fees and dues. This allocation of more than half of the funds to the local bodies is the tangible expression of the theory of putting on the local chapters major responsibility for the service which the association is to render its members.

The thinking in engineering societies has been drifting in this direction for a long time. The American Society of Mechanical Engineers and the American Institute of Electrical Engineers have been particularly active in trying to strengthen their local bodies. The same object was one of the cardinal doctrines of the progressive movement in the American Society of Civil Engineers. It should be noted, however, that none of these organizations has even dreamed of the degree of decentralization contemplated by the A.A.E. plans. This is indicated by the degree of financial assistance which they extend, or propose to extend. In the American Society of Mechanical Engineers, for example, the average contribution from national headquarters to the sections amounts to $1.25 per member, out of a full membership fee of $15, or 8⅓ per cent; the sections also receive 20 per cent of the initiation fees. The proposed constitution of the American Society of Civil Engineers, now going to letter ballot, provides that the contribution by national headquarters shall not exceed $3 per member, which is less than 15 per cent of the average dues. In other words, these national societies, while they propose to strengthen their local bodies, adhere to the principle that the main strength must lie in having a strong central organization. Their theory is one of centralization; that of the A.A.E., of decentralization.

Which of the two theories will prove to be the better remains to be seen. Tradition would lead us to be fearful of the results of the A.A.E. plan. Our older national engineering societies have, heretofore, functioned mainly as headquarters organizations. Even while the advocacy of the strengthening of the local bodies has been vigorous the proponents themselves have been fearful lest the granting of too much autonomy might detract from the soundness and prestige of the whole body. The advocacy of decentralization, therefore, loud as it may have been at times, has been decidedly conservative. Though the A.A.E. policy is not fully crystallized, the evident drift is toward giving the locals almost complete autonomy. In national questions, obviously, the chapters could not function except through national headquarters. On local matters it seems to have been concluded that the local bodies are the best judges of the desirable procedure.

Obviously, the success of the venture will depend upon the judgment displayed by the chapters. To be strong nationally the engineering profession should be strong locally, for the local problems coming before engineers are those that most directly interest and enlist the sympathy of the public. If A.A.E. chapters throughout the country grasp and handle those problems to the credit of the profession and at the same time continue loyal adherence to the national body the decentralized policy will be adjudged successful.

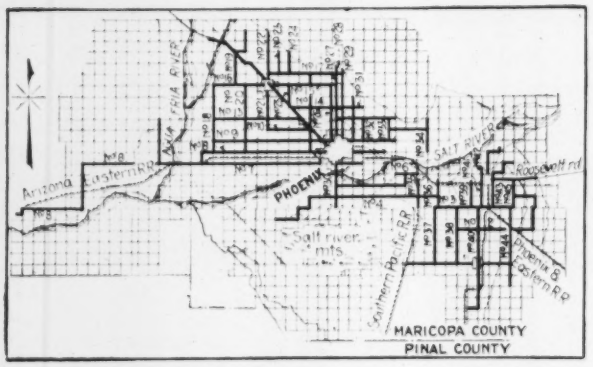
Arizona County Undertakes 309-Mile Paved Road System

Special Concrete Slab Section and Construction Methods Devised for Hot Dry Climate—System Brings Every Farm Within One Mile of a Concrete Road

By Ralph Rollins
Phoenix, Arizona

Maricopa County, Arizona, a comparatively small section of one of the least-populated states, is engaged in the most ambitious concentrated road program in the country. Not only is the mileage, and consequently the expenditure, per capita high, but the contract methods are unprecedented; one contractor is doing all the work under the first or $4,000,000 bond issue. In the following article the general outlines of the job are laid down, to be followed later with detail stories of how the roads are being built. Night work, for instance, is now being successfully prosecuted, and a description of that makes a story in itself.—Editor.

With 141 miles of concrete road under construction and 309 miles planned, Maricopa County, Arizona, leads all counties in mileage of paved road under contract and in volume of bond issues ($8,500,000) for highway improvement. The contract for the 141-mile section, undertaken by Twohy Bros. Co., is the largest single paved-road contract ever awarded. A slab section, thickened at the edges, unique in its employment for so great a mileage, is being constructed. The development of local aggregates for the whole mileage has been undertaken with large-capacity equipment. Machinery is employed in construction in every practicable manner, and with five paving mixers 3,000 ft. of road is being completed each day worked.



CONCRETE ROAD SYSTEM FOR MARICOPA COUNTY, ARIZ.

Location and Plan.—Maricopa County is the largest county in Arizona in point of population though not in assessed valuation. Its county seat, Phœnix, is the capital of the state and the metropolis of the Salt River valley, at one time a barren desert but now under intensive cultivation by virtue of a federal reclamation project under the Roosevelt dam. The highway program is being financed by two bond issues, one for $4,000,000 and the second for $4,500,000, the latter being voted before more than $1,000,000 of the original issue had been spent. The second issue, though voted, has not yet been sold. Actual construction started Nov. 12, 1920, and four months later, March 12, 1921, 32 miles of paving 18 ft. and 16 ft. in width and 6 in. and 5 in. in thickness had been laid. With five pavers in operation the contractors were then laying over 3,000 ft. per day.

As planned, the Maricopa County highway system is designed to place every farm house in the valley within one mile of a paved highway. The project comprises a series of main arteries of heavy construction to carry the heavy traffic, supplemented by parallel and cross roads of lighter construction, which will serve all sections of the irrigated district and also provide facilities for through traffic.

The selection of concrete as the material for these roads was made by the county highway commission after investigation of the adaptibility of all materials and methods to local soil and weather conditions. Between concrete and asphalt, the final choice was decided by price. It was found cheaper, all things considered, to build all-concrete roads than roads with concrete base and asphaltum surface, or with asphaltic-concrete base and asphaltic surfacing. Twohy Bros. secured the contract, let under competitive bidding, at the following figures: For 18-ft. 6-in. road, $31,400 per mile; for 16-ft. 6-in. road, $28,300 per mile, and for 16-ft. 5-in. road, $25,350 per mile. These figures are for complete road, including concrete culverts, bridges and all necessary drainage.

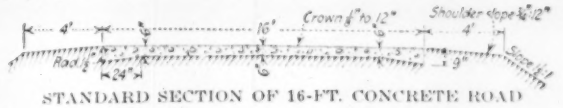
For the 18-ft. pavements, the subgrade has a 1-in. crown. Two feet from each edge it is beveled off to provide a thickness of 9 in. of concrete at the edge. The center of the pavement is 6 in. thick. One-inch crown is used in the paving, whether 16 ft. or 18 ft. wide or whether 5 in. or 6 in. thick. In the 5-in. paving, however, the thickness at the edge is reduced to 8 in. All of the 18-ft. paving thus far has been laid 6 in. thick and about one-half of the 16-ft. paving has also been laid 6 in. thick.

Plan of Construction.—In planning construction the system was divided into nine districts, in the center of each of which was to be set up a plant for the distribution of materials, each plant being accessible by rail. The aggregate is supplied from a central plant erected on the south bank of the Salt River at Tempe, and the materials are hauled from this plant by standard-gage equipment to the distributing plants. There is one exception to this general plan on a sub-contract for work south of Phœnix. Here an independent gravel plant has been erected which supplies materials which are transported by motor truck to the one paver on this unit.

The Tempe plant will furnish materials for the entire work, it being the intention to move the set-up from one district distributing point to another as the work in each district is completed. Each district plant is constructed of frames and walls made up in units and held together by bolts, in order that they may be quickly as-

sembled and knocked down. Two district plants have been built to date.

The construction is remarkable for the extent to which machinery and appliances have taken the place of labor. From the time the raw material is scooped from the river bed at Tempe to the time it is laid down on the sub-grade in the form of concrete, it is not touched by hand, nor, more important still, does it



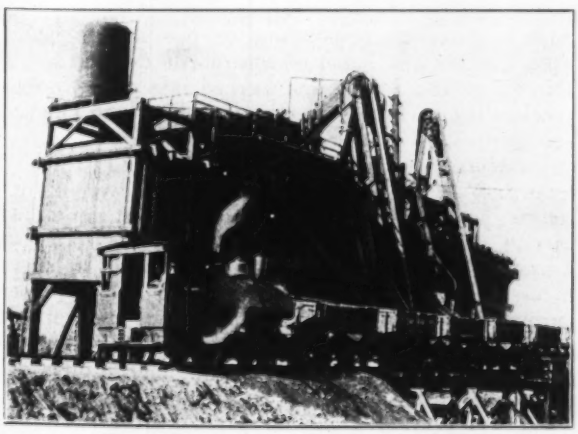
STANDARD SECTION OF 16-FT. CONCRETE ROAD

come in contact with the earth. The result is a clean, pure mix, free from dirt, twigs and other foreign matter.

Central Materials Plant.—At the point where the materials are excavated the bed of the stream is approximately half a mile wide, but the stream itself occupies only a fraction of this area except in rare times of flood. At present and for some time past, the stream has accommodatingly followed the north bank of the river, leaving an area of about 40 acres on the south side to be worked without interruption.

Approximately one mile of track is required to transport the raw material to the crushing plant. The material is excavated by a 70-ton steam shovel with a bucket capacity of 2½ cu.yd. Two shovelfuls constitute a load for one of the dump cars and six of these constitute a train operated by a dinky locomotive.

From the cars the material is dumped onto a grizzly designed to pass rock up to 2½ in. in diameter. The oversize stones fall onto a conveyor which carries them to a gyratory crusher. The crushed material, as well as that which has passed through the grizzly, is then elevated by means of a 60-ft. bucket elevator to the top of the washing tower. Here the material passes through a rotary washer, the oversizes being automatically returned to the crusher. All material under 2¾ in. in size is dropped through to the retaining bins for the rock. The fine materials are then passed through sluice boxes and washed to eliminate silt and débris, which are carried off with waste water through a flume. This leaves nothing but clean wet sand, which is carried by another flume to the sand pile. The sand is well graded from ¼ in. down and averages about 1 per cent passing a 200-mesh screen. The vegetable



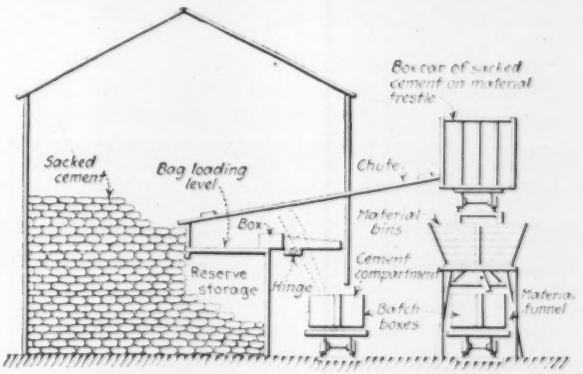
AGGREGATE WASHING AND SCREENING PLANT. 1,500 TONS DAILY CAPACITY

content, as determined by colorimetric test, is practically negligible, the solution remaining perfectly clear.

All the equipment described is in duplicate, the material passing through the grizzly being conveyed to either one or both of the two crushers and from there elevated by either one or both of the two elevators, into their respective screens and washing plants. The daily capacity of the plant is 1,500 tons.

Distributing Plants.—From the central plant storage bins, the gravel is loaded by chutes into dump cars of 30-cu.yd. capacity; the sand is loaded by crane and 1½-cu.yd. clamshell. A special engine and crew are assigned to the sand and gravel trains. On an average, two trains of 16 cars each, are handled each day.

Each distributing plant consists of storage accommodations for sand, rock and cement, so arranged as to provide easy loading for the industrial railroad which conveys the material from the distributing plant to the points where the pavers are in operation. The standard-gage tracks are elevated sufficiently to allow

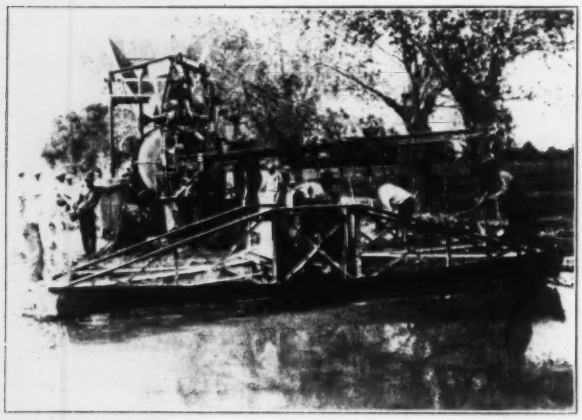


SKETCH SHOWING CEMENT HANDLING BY SACKS

the dumping of the sand and rock into the bunker, 300 ft. in length. This is built with inclined sides, averages 20 ft. in width and is 14 ft. deep. One-third of the bunker is for sand and two-thirds for rock. The practical storage capacity is 500 cu.yd. of sand and 1,000 cu.yd. of rock.

At the beginning of the job cement was shipped in bulk. The cement house is double-ceiled with building paper, is 25 x 80 ft. and has a storage capacity of 25 carloads. The cement was pumped from the cars by a vacuum pump, operated by a 62-hp. motor, either into the storage bin or onto a conveyor, 73 ft. long, which discharged into two double hoppers used for loading the industrial cars. It took approximately three hours to unload a car of bulk cement. There are also storage facilities for cement in sacks to provide for any interruption which may arise in the other method of handling. As a matter of fact the suction unloading method did not prove very satisfactory. The principal difficulty appeared to be the grinding out of the locks, due to the peculiar gritty quality of Western cement, which characteristic was apparently not taken into consideration by the manufacturers of the device.

[After Mr. Rollin's article was put into type a description of the cement-handling plant, as at present installed, was received. This plant is roughly sketched in the accompanying drawing. Cement is shipped in sacks, the cars being spotted on the material trestle so that gravity assists the movement of bags to cement



CONCRETE PAVING MIXER AND FINISHING MACHINE

sheds. The bag-loading level is above the reserve storage and of sufficient height so that a line of boxes, each holding four bags of cement and each having a chute, may be tipped by a man on the ground level and the cement discharged into the batch boxes on the cars. There are 48 of these boxes, sufficient to load two 12-car trains and so spaced that one spotting of the train allows for its entire loading. Reserve-cement storage is that which would be below the charging level, at which point a platform is built. Each box, holding 4 bags of cement, is so balanced that a man on the ground may reach up to the chute at the end of the box and tip it down, discharging the cement into the cement compartment in the batch box.—EDITOR.]

Industrial Railway Haulage.—In loading the industrial trains the cement is loaded first. Each truck carries two batch boxes, with compartments adjusted to provide one part of cement, two of sand and four of rock. The cars are spotted opposite the cement storage and loaded with four bags of cement or one barrel, and when filled the compartment is closed with a metal lid. After a train has been loaded with cement the cars are shunted into the loading tunnels formed by the rows of stanchions supporting the hopper. When properly spotted there is a chute above each car, each equipped with a lever and automatic cut-off.

Twelve cars, each with two batch boxes, and with each box containing 3,300 lb. of material, constitute a train, the total net load being nearly 40 tons. Each train is hauled by a 6-ton gasoline locomotive of the friction drive, four-cylinder type, and is operated by one man.

The entire industrial railroad for two distributing plants consists of 14 miles of track, 216 cars and 14 locomotives. The track is in 15-ft. sections with riveted pressed-steel ties. The shifting is done at night to prevent delay in paving. Seven and a half miles is the limit haul, this being the maximum distance from a distributing plant to the boundary line of that district. In each of the two districts now under construction, there are seven locomotives, each making from three to four trips a day, and from eight to ten trips to each of the pavers is made each day.

Concreting Procedure.—At the pavers, the batch boxes are lifted from the truck of the industrial train by the weight of the descending skip after it has unloaded the preceding batch into the retaining drum of the mixer. After 14 revolutions, or one minute lapsed time, the 18-cu.ft. batch of concrete is dumped into a skip on an 18-ft. boom and worked into place by four spreader men. Following the paver is a road finisher, equipped with a strike-board, tamper and a belt. A lute is sometimes used for the final finish.

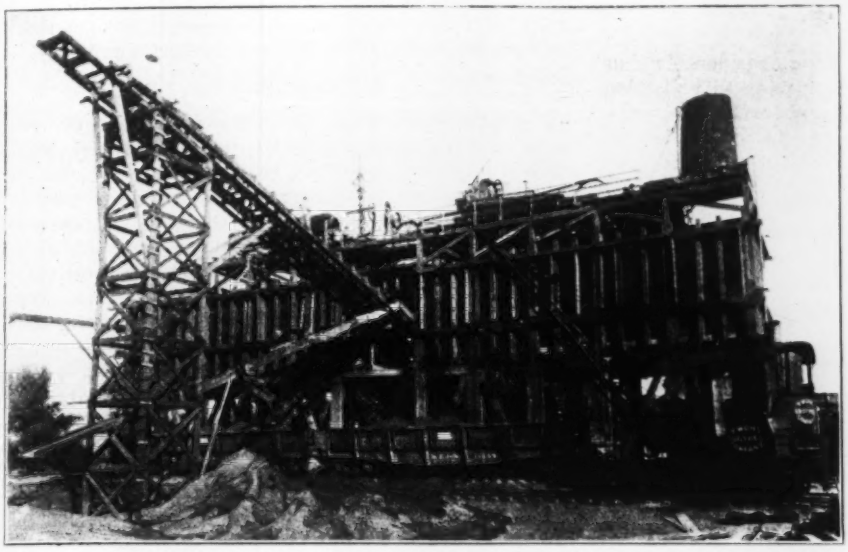
PONDING SYSTEM FOR CURING FINISHED PAVEMENT

As fast as the paving is finished it is covered with canvas, supported on frames made in 20-ft. units and carried on eight flanged wheels using the forms as a track. This covering which is about 150 ft. in length is used to prevent hair cracks and to aid in proper curing. Frost is practically unknown, but to offset this advantage there are a glaring sun, excessive dryness of the atmosphere and extremely high temperatures, all of which contribute to the formation of hair cracks, which are prevented only by taking the utmost precautions in the early stages of setting.

As the sunshade is pushed forward behind the fin-

isher, the surface is kept constantly moist by the spray from a hand nozzle. The next step is to cover the surface with 2 in. of soil and 2 in. of water is kept standing over the dirt for a period of sixteen days, following which the mud is allowed to dry, and is scraped off on the twenty-first day. A view of a ponded stretch is shown herewith.

To provide water for ponding and other operations, a 2-in. water main is laid along the road, sometimes for a distance of 2 miles or more. Sometimes irrigation ditch water is available and sometimes well water is used, but in either instance the water is first analyzed to determine the percentage of alkali, and if more than a trace is found another source has to be located and tested. Six portable gasoline pumps, each with a capacity of 60 gal. per min., furnish the water for the sub-grade, mixers and curing.



LOADING SAND FOR MARICOPA COUNTY ROADS AT CENTRAL PLANT AT TEMPE, ARIZ.

The slab is laid without expansion joints of any sort except those which are put in at the completion of each half-day shift.

Grading Procedure.—The valley is for the most part as flat as a marble slab. There are, therefore, no grades but to offset this the engineers have to plan culverts and bridges for the numerous waterways used for irrigation. As a rule the ditches are graded above the surrounding lands, so that every time one crosses the highway, the latter must be elevated. Otherwise the highway would have to be built on a uniform 4-ft. fill.

This plan was considered and abandoned, because of the additional expense, and because of the fear that the raised highways would act as dams to prevent the free escape of flood waters which occasionally visit certain sections. Except at ditch crossings, no grade is more than 1 per cent.

After the rough grade is established the forms are placed and a 10-ton roller is used to draw a sub-grader. The earth planed off by the blades of the sub-grader is left in two windrows. This material is first used to fill in low spots and the surplus is shoveled outside the forms to be used later to cover the pavement for curing and later to form the shoulders, 4 ft. wide on each side of the 16-ft. and 3 ft. wide on each of the 18-ft. pavements.

In the 32 miles of paving laid to March 12, not a single longitudinal crack has appeared; this is attributed to the heavy-edged cross-section, and to the care exercised in curing the slab and in preparing the subgrade. Excessive subgrade rolling is not permitted. Other factors in the success of the work are clean materials and a dry mix. Just enough water is used in mixing the concrete to form a plastic workable mixture.

Supervision.—Two men are employed to check operations at the central plant at Tempe, and there is also an inspector with each mixer. A resident engineer checks up the subgrade and the forms in each district. In addition to these, the engineering force consists of one chief engineer, one assistant engineer, one office engineer, three draftsmen, and one construction engineer in charge of the testing laboratory, which is completely equipped and where daily tests are made of sand, rock, cement and water as well as corrugated pipe, which in some instances is used in conveying irrigation water beneath the paving. The work is in charge of R. C. Perkins, chief engineer, Maricopa County Highway Commission, Phœnix, Ariz. Most of the equipment, notably that used for the handling of materials, together with the cars, track, batch boxes, pavers, finishers, sub-graders and pumps were furnished by the Lakewood Engineering Co., of Cleveland.

Advancing the Engineering Profession

Sixth, and finally, the ambitious engineer should remember that the individual cannot advance himself much beyond the attainments of his professional brethren. If many engineers are narrow in their views, lack initiative, are weak in executive ability, and poor in English, then the standing of the profession is low in the estimation of educated laymen and of other professional men; and any engineer who strives for a large professional success may be materially handicapped by the reputation of his professional brethren. Here, then, is the need of a real missionary. A missionary is one who conscientiously tries to help others to a higher, more useful, and more noble life. The graduate members of this fraternity should do all within their power to persuade all engineers that the highest success of the individual and the greatest advancement of the profession depends upon the technical knowledge of its members, but also depends to a large degree upon the breadth of view, the initiative, the executive ability, and the capacity of the individual to write and speak clearly and forcefully.—*Ira O. Baker, professor of civil engineering, University of Illinois, before 1921 convention of Triangle Fraternity of Engineers.*

Relation of Union Schedules to Building Operations

By William Joshua Barney
Barney-Ahlers Construction Corporation, New York City

The following discussion of so-called open-shop and union influences in the building industry was contained in a letter written recently by Mr. Barney to the head of a large industrial organization in Buffalo, N. Y.—Editor.

TO ONE like myself who is giving considerable time personally to studying and considering this question of relation between building trades labor and employers, an inquiry like yours of April 13 is of very decided interest. The subject is a very large one to be covered by letter.

I note that you state the position, natural under present economic conditions, of the manufacturer towards organized labor. There is however, an essential difference in the relations between labor employed in the building trades and labor employed in the ordinary manufacturing process. You manufacturers have a decided advantage inasmuch as under normal conditions you are dealing with a more or less constant personnel, permitting direct relations between yourself and your employees on the theory that a decidedly large portion of those participating from the labor side will be in your employ for a number of years, and more or less steadily.

Many of your employees doubtless own homes in the neighborhood of your plant and, through local interest and pride in the company, can be directly appealed to and dealt with through employees' committees, through welfare work, through bonus systems, etc. and with whom in a strict business sense, wages can be talked over, as it were, between man and man. On the other hand, in the building trades a contractor employs mechanics only for the brief period of a building operation—and seldom the same group of mechanics. It is true that some of our largest construction companies, especially during the recent busy period of war and post-war construction, were able to keep a certain number of their carpenters, bricklayers and other mechanics steadily employed. The fact remains however, that the spirit of the relations between the contractor and his employees is not based on the theory of constant employment of the same personnel.

Value of Union Contracts

Consequently, in order to take care of this ever-shifting labor personnel, and to agree upon terms and conditions of employment as well as rates of wages, it is unquestionably a convenience and necessity to the building contractor to have labor organized into separate groups of its own and speaking through authoritative representatives with whom agreements covering a period of time can be made. Otherwise it would be practically impossible for any contractor to undertake a lump-sum piece of work extending over a long period of time.

Frankly, I believe that it would be impossible for any contractor to have even the appearance of working under "open shop" on any work of magnitude, except under peculiar local conditions such as theoretically are supposed to exist in Buffalo. For example, here in New York at present, work is scarce; and, undoubtedly, mechanics would be willing to work at rates of wage considerably lower than those now officially prevailing. On the other hand, as soon as the house-building season starts, as it will soon with low-priced houses, the mason and carpenter will be very extensively employed; and, under an open-shop arrangement, wages would immediately jump. *In 1919 in some cases on so-called independent or open-shop work, they rose to a rate of $17 and $20 per day.* How could an industrial or large-sized contractor exist under such conditions as that? Only on the undesirable "cost-plus-percentage" basis.

Dual Responsibility

I hold no brief for the unreasonable exaction of labor as to working conditions and wages; and, with other employers here in contracting, am doing my best to obtain correction of the many abuses that crept in during the unusual conditions of the war and post-war periods. Nor, on the other hand, have I great sympathy with the attitude of some employers who seem to think that "now that we have them in a corner, give them hell, boys." In other words, I think these undesirable extremes in the relations between employer and employee are apt to result from extreme economic conditions, and I believe that the firm business basis of a stabilized building industry can come only from an intermediate and consistent course of reasonable agreement between employers and employees, and I think the greater responsibility for moderation rests with employer, for obvious reasons.

We operated in Buffalo last year under the so-called open-shop conditions; but to all practical purposes, they might as well have been union conditions as exist in New York. Frankly, it would have been far more satisfactory both from the standpoint of estimating the cost of our work and of carrying it out, as we could draw from no personnel or long-established group of employees.

Now as to the wage rates themselves, in most cities agreements expire either on April 1 or May 1. Desiring to reduce the cost of building operations and to secure greater efficiency, many employers' associations, at the sacrifice of their business prospects this year, have entered into an attempt to compel labor to take a reduction in wages. Where these attempts are based upon moderation and with a reasonable relation to the reduction of the cost of living and changed conditions, they will undoubtedly be successful without much friction and will result in lower building costs without strikes and their consequent expenses. In some places however, employers have endeavored to obtain 25 or 30 per cent cuts, which, in my opinion, can only result in a long and costly trouble during this summer with the inevitable compromise at the end.

Labor Rates and Cost

In New York City the building trade agreements expire on Jan. 1, 1922. So there will be little, if any possibility of a change in the *rate* in the building trades locally, as the employers cannot afford to lose the moral advantage they have always had in the fact that they have never broken their agreement. As you can readily imagine, labor will hardly be coming forward voluntarily to suggest cuts even though for its ultimate benefit, through the consequent stimulation of building. I, as well as other large builders, recognize the necessity for reducing the cost of building as rapidly as

possible to stimulate building operations; but on the other hand, this cannot be done in a radical or "Bolshevik" manner without laying the foundation for much future trouble over a long period.

Now as to the *cost* of labor. There has been a very startling reduction in the cost of labor in building operations. Not only have the incompetent, unambitious and unskilled mechanics of the war period gradually disappeared through the keener competition for places, but the skilled mechanics now working are very anxious to keep their jobs and consequently are producing "a hundred cents on the dollar." Today, work can be organized along the lines of highest efficiency, planned with complete mechanical equipment, and with the knowledge that the labor organization, from the foreman down, will be working zealously, anxiously, and keenly for the interest of the contractor and the owner in order to reduce cost and time of building operation. There are very few of the trades, in this respect, that do not realize the war is over. Possibly in one or two of the minor building divisions where there still exists a scarcity of the particular skilled labor required, there remain traces of the post-war inefficiency; but they are so slight as hardly to affect the large reduction of costs in other directions.

Moreover, the enormous bonuses for over-time work, the excessive transportation costs in order to get your materials through on time, the absolute undependability in quality and workmanship of manufactured materials, have very largely, if not entirely, disappeared, at least in this section of the country.

Return Water Pumped 300 Feet To Serve Utah Irrigation Project

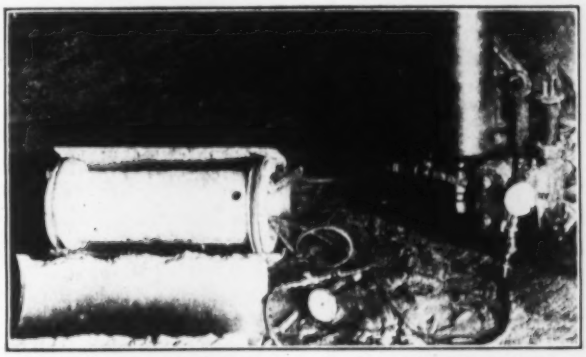
The Bonneville Irrigation District is now building works in Davis County, Utah, to supply water to 4,860 acres. The water is diverted from the Jordan River just north of Salt Lake City and consists of the return water from seepage and waste from lands higher up on the river which would otherwise flow unused into Great Salt Lake. A pumping plant is being installed to lift the water to two levels, 150 and 300 ft., respectively, above the source of supply. When another 5,000 acres are included in the district the development cost will be approximately $70 per acre, it is claimed, which is said to be much lower than that of gravity system in the vicinity. The development is to be finished about July 1, in time to deliver water for this season's crops.

The pumping station, located near a 44,000-volt transmission line, contains four pumping units, each direct connected to a 2,300-volt motor. The motors used on the 300-ft. head are rated at 1,200 hp. and 700 hp., respectively, while those on the 150-ft. head are 600 hp. and 350 hp., respectively. The pumps are all single-stage, double-suction centrifugals having 20-in. and 15-in. discharges delivering 25 and 15 sec-ft., respectively. The pumps on the 300-ft. lift are connected in series.

The operation, maintenance, depreciation and amortization charges for the first 20 years are estimated at about $10 per acre-foot of water required, or an average of $23 per acre of land now in the district. After this period the bonds issued for the construction of the pumping plant will have been retired and the charges are to be reduced to about half the initial rate.

Device for Testing Sections of Concrete Pipe

A DEVICE has been developed by the California Association of Cement Pipe Manufacturers with which hydrostatic tests can be made on single sections of concrete pipe without the use of false ends and tie-rods. After several modifications of the original, the form described in the following has been adopted as standard and the same design is used for various pipe diameters.



DEVICE FOR HYDROSTATIC TEST OF CONCRETE PIPE

The device consists chiefly of two aluminum cylinders, fitting one inside the other, and both of which have flanged ends. A tubular gasket made of rubber fits between the inner and outer flanges at each end of the cylinder. The outer flanges can be adjusted so as to fit tightly against the inside shell of the pipe, and after this has been done the rubber tubes are inflated with water pressure. The tubes are similar to inner tubes for automobile tires and are supplied by a separate hose from the pump. By forcing water into the tubes they are tightened against the concrete, and then water is admitted to the main pressure chamber, or space between the outer aluminum cylinder and the inner face of the concrete pipe. The pressure in the tubular gaskets and in the main pressure chamber can be supplied from the same source and increased at the same rate after they have separately been brought up to about 50 lb. Beyond this point the pressure in the main chamber is sufficient to hold the gaskets against the outer flanges.

Water pressure is ordinarily supplied by some form of hand pump, two gages are used, one to register the pressure of water in the rubber gasket, at the start of the test, and another on the supply line to the main pressure chamber. This main pressure gage is connected by rubber tubing to a small hole seen in the accompanying illustration to the left and below the opening which admits the water. This illustration shows a 10-in. testing device in a pipe section which has been broken by internal water pressure.

Pressures up to 260 lb. per square inch have been used with an 8-in. testing device of this design, although about 150 lb. per square inch is considered the safe limit for apparatus now in use. Improvements in the apparatus which are now under consideration are expected to raise the safe limit to a higher figure.

The foregoing was compiled from information supplied by F. W. Stanley, engineer for the California Associated Concrete Pipe Manufacturers.

Labor Hours Per Output Unit In Building Construction

Tables Showing Time Required To Accomplish a Unit of Carpenter Work, Masonry, Excavation, Painting, Plastering and Sheet Metal Work

By Frank E. Barnes
Supervising Building Valuation Engineer, New York Central Lines, New York City
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IT IS a well-established fact that one of the greatest difficulties which building contractors have to face is to estimate with reasonable accuracy the amount of labor necessary to install various kinds of building material. Yet this knowledge is essential in order to figure correctly the cost of construction. There has been an increasing demand for reliable information of this nature. The accompanying tables are presented in the hope that they may be of assistance to estimators and others engaged in contracting. They are the result of painstaking research and the data from which they were derived were furnished by successful contractors of wide experience. No data were used that seemed in any way to include inconsistencies.

The information was required to establish unit prices as of 1914 for use in the valuation of some 30,000 buildings, constructed between 1880 and 1918, located throughout the northeastern part of the United States including such large cities as Boston, New York, Cleveland, Cincinnati, Chicago and St. Louis. In all of the unit prices required, the amount and cost of material and the cost of labor per hour could be established from existing records. There had to be determined, however, the number of labor hours. Therefore, a comprehensive questionnaire was prepared and sent to leading contractors throughout the section of the country where the buildings were located, asking for the amount of material that could be installed per day in each of the various classes of carpentry and masonry work entering into building construction. These returns were then tabulated and compared. Where any inconsistencies were found, they were returned to those who had furnished the information for review and revision. If apparent inconsistencies could not be entirely cleared up, the whole data would be rejected. After a very thorough and exhaustive study and comparison had been made and all errors eliminated, the average of the resulting figures was used in preparing the tables.

Some contractors, by thorough and careful supervision, get more work from a gang of men than do others. On rough work, such as heavy factory construction or large buildings, men can install more material per day than they can on private residences or small buildings. Differences such as these cannot be taken into consideration in tables of this kind. Unusual conditions should be taken care of by the estimator in preparing his unit prices.

It should also be stated that these tables were prepared for labor showing the efficiency that was common before the World War and on the assumption that proper supervision was exercised to secure the best results. They would not apply to the grade of labor that prevailed during 1919 and 1920, nor to the inferior labor that is sometimes secured in country districts and small towns.

Carpenter Work—The percentage of waste shown in Table I was figured on the assumption that ½ in. is used in the width of boards for squaring of edges and ¾ in. for matching and that an additional 10 per cent of waste is required for cutting, sorting, etc. The tables can be used to figure the cost of the carpenter labor only, or the cost of the carpenter and common labor used in conjunction with the carpenter work. To illustrate: If twelve carpenters are used on a job with three common laborers, the carpenters receiving 75c. per hour and the common laborers 40c., the price of one carpenter should be added to one-fourth of the

TABLE I. CARPENTER WORK

Kind of Work	Per Cent of Waste	No. of Hours per M.B.F.	Cost at c per Hour
Nov. drop sid. 5½ in. to W	25	17 6	....
Clapboards 4½ in. to W	46	17 8	....
Board and batten siding	10	17 3	....
6-in. wall sh. str. SIS2E	19	12 6	....
6-in. wall sh. diag. SIS2E	24	15 3	....
6-in. under fl. str. SIS2E	19	10 9	....
6-in. under fl. diag. SIS2E	24	12 9	....
Roof sh. str. 1x6 rough	10	12 7	....
Roof sh. str. 1x6 D. & M	25	12 8	....
2-in. fl. plk. on joist, SIS2E	16	6 9	....
3-in. fl. plk. on joist, SIS2E	16	5 2	....
Fin. fl. on und. fl. 13/16x2½	43	21 7	....
Fin. fl. on und. fl. 13/16x3½	33	20 3	....
Fin. fl. on und. fl. 1 1/16x3½	33	16 2	....
Fin. fl. on joist 13/16x2½	43	22 4	....
Fin. fl. on joist 13/16x3½	33	21 0	....
Fin. fl. on joist 1 1/16x3½	33	17 5	....
Wall and ceil. sh. 1x3 D. & M	43	21 7	....

TABLE II. CARPENTER WORK

Kind of Work	Unit of Work	No. of Hours	Cost at c per Hour
Nov. drop sid. 5½ in. to W	100 S.F.	2 2	....
Clapboards 4½ in. to W	100 S.F.	2 6	....
Board and batten siding	100 S.F.	1 9	....
Wall sh. str. 1x6 in. SIS2E	100 S.F.	1 5	....
Wall Sh. diag. 1x6 in. SIS2E	100 S.F.	1 9	....
Under fl. str. 1x6 in. SIS2E	100 S.F.	1 3	....
Under fl. diag. 1x6 in. SIS2E	100 S.F.	1 6	....
Roof sh. str. 1x6 in. rough	100 S.F.	1 4	....
Roof sh. str. 1x6 in. D. & M	100 S.F.	1 6	....
2-in. fl. plk. on joist, SIS2E	100 S.F.	1 6	....
3-in. fl. plk. joist, SIS2E	100 S.F.	1 8	....
Fin. fl. on und. fl. 13/16x2½ in	100 S.F.	3 1	....
Fin. fl. on und. fl. 13/16x3½ in	100 S.F.	2 7	....
Fin. fl. on und fl. 1 1/ 16x3½	100 S.F.	2 7	....
Fin. fl. on jois 13/16x2½	100 S.F.	3 2	....
Fin. fl. on joist 13/16x3½	100 S.F.	2 8	....
Fin. fl. on joist 1 1/16x3½ in	100 S.F.	2 9	....
1x3 in. side wall and ceil. sh	100 S.F.	3 1	....
Wood shingles	100 S.F.	3 1	....
Asbestos shingles	100 S.F.	3 4	....
Slate roof	100 S.F.	2 9	....
Prepared roofing	100 S.F.	1 5	....

TABLE III. CARPENTER WORK

Kind of Work	Unit of Work	No. of Hours	Cost at c per Hour
Box fr. wind., incl. frame	Each	4 3	....
Pl. frame wind., incl. frame	Each	3 1	....
Hinged door, incl. frame	Each	5 0	....
Hinged door and trans., incl. frame	Each	6 1	....
Sliding door, incl. frame	Each	8 1	....
Sliding door and trans., incl. frame	Each	9 7	....
Grounds in frame building	100 L.F.	2 5	....
Grounds in masonry building	100 L.F.	3 6	....
One member base board	100 L.F.	4 5	....
Two member base board	100 L.F.	6 2	....
Chair rail	100 L.F.	4 1	....
Picture molding	100 L.F.	3 4	....
Mold. top of wainscot	100 L.F.	3 7	....
Mortised and tenoned framing	1,000 F.B.M.	21 4	....
Studding	1,000 F.B.M.	17 9	....
Floor and ceiling joists	1,000 F.B.M.	15 4	....
Rafters for gable roofs	1,000 F.B.M.	21 1	....
Rafters for hip and val. roofs	1,000 F.B.M.	26 5	....
Floor sleepers in sand	1,000 F.B.M.	22 7	....
Floor sleepers in conc	1,000 F.B.M.	26 8	....
Roof trusses 20 to 40 ft. sp	1,000 F.B.M.	32 3	....
Cornice ordinary plain	1,000 F.B.M.	37 9	....
Wood lath	M	5 7	....

rate of common labor or 10c., making a total of 85c. per hour. It is possible to include the carpenter foreman also if this seems desirable. For instance, if the foreman received $10 a day and the payroll of the carpenters and common laborers under him is $100 a day, then an additional 10 per cent should be added, 8½c., making 93½c. per hour as the entire cost of carpenter labor together with helpers and foreman, which, multiplied by the number of hours shown in the table, will give the cost of installing the various kinds of material specified.

Masonry Work—In figuring the masonry work the following general assumptions were made: That seven

TABLE IV. MASONRY WORK

Kind of Work	Unit of Work	No. of Hour	Cost at ¢ per Hour
3-in. hol. tile part.	100 S.F.	3 0	
4-in. hol. tile part.	100 S.F.	3 1	
2-in. wall furring.	100 S.F.	3 0	
24-in. brook tile.	100 S.F.	2 6	
8-in. hol. tile in ext. walls.	100 S.F.	4 4	
16-in. found. walls strk. jnts.	1M. brick	5 6	
16-in. factory walls, no pilas.	1M. brick	6 7	
16-in. wall, pilas, cornices, etc.	1M. brick	8 2	
12-in. factory walls, no pilas.	1M. brick	8 2	
8-in. factory walls, no pilas.	1M. brick	10 2	
12-in. wall, pilas, cornices, etc.	1M. brick	9 3	
8-in. wall, pilas, cornices, etc.	1M. brick	12 0	
8 and 12-in. backing stone ashlar.	1M. brick	7 6	
8 and 12-in. backing face brick.	1M. brick	7 8	
Face brick clipped bond.	1M. brick	17 5	
Face brick Flemish bond.	1M. brick	21 0	

brick should be figured for each superficial foot of wall 4 in. or one course thick; fourteen for two courses, twenty-one for three courses, etc., and that in figuring outs all openings should be figured full size, corners taken but once, and pilasters, corbles, etc., figured their exact size. In estimating wall and book tile, the net area should be figured. In case, however, of inches in the length or width of a wall, the next foot should be taken, and in estimating the area of openings, inches in dimensions of width or height should be omitted.

For filling in the cost column in Table IV, the rate per hour is intended to cover not only the cost of mason labor, but also that of hod carriers. When an equal number of each are used on a job, the rate per hour for masons should be added to the rate per hour for hod carriers and the combined figure used. If, however, more or fewer hod carriers are used than of masons, then a corresponding percentage should be added to or subtracted from the rate paid hod carriers before adding it to the mason's rate. For example, if masons are paid 80c. and hod carriers 40c. per hour and 10 per cent more hod carriers are used than masons, we would add 80c. to 40c. + 10 per cent of 40 or 44c., giving a total of $1.24 as the combined figure. In case it is desired to include the mason foreman, it can be done in the same manner as described for the carpenter foreman.

Excavation and Sheet Piling—The information for Table V was prepared by the same method and the same degree of carefulness exercised as in the tables for carpenter and mason work. It is for work done by the pick and shovel method only. The first column specifies briefly the kind of work, but any other excavation which is done by the pick and shovel method can be included by putting it under the heading most nearly fitting the conditions.

Each kind of work is figured for three kinds of soil: The first, "Light Loam or Sand," is intended to include any soil that can be shoveled with little or no picking. The second, "Heavy Loam or Medium Clay," includes soils that are easily loosened by pick and handled by shovels without much difficulty; while the third, "Hardpan or Cemented Gravel," includes those that are loosened by difficult picking or are of such a sticky nature that the shoveling is slow and expensive.

The work is again divided for conditions of soil, whether wet or dry. All soils are considered dry when it is not necessary to do considerable pumping and bailing, or to sheet pile, to keep out the water. The column "Team Haul" is intended to include a man and team. Where the haul is for distance greater than 500 ft., the cost can be figured on the assumption that a dump wagon holds 1½ cu.yd. and that a team will walk on an average of two miles per hour. Therefore, the time required to haul 1 cu.yd. one mile would be 0.67 hr., or for each additional 1,000 ft. haul, would be 0.125 hr.

The cost of sheet piling for cellars and trenches is for average work and the hours specified are for one carpenter, but on the assumption that two or more carpenters work together where more than one man is needed to do the work economically. The amount of lumber specified for sheet piling is on the assumption that 2-in. plank will be used and that 1 in. additional per square foot will be required for string pieces, bracing, etc. It is also assumed that the lumber is used twice. If, for any reason, it can be used only once, then the amount of lumber shown in the table should be doubled, and if used more than twice, a corresponding reduction can be made.

The cost of the work has not been carried out as the price of labor and material varies so much for different sections of the country.

TABLE V. EXCAVATION AND SHEET PILING
(Pick and Shovel Method)

Kind of Work	Kind of Soil (1) Dry (2) Wet	Hours per Cu. Yd. —Common Labor— Exc.	Backfill	Total	Team Haul Under 500 Ft.
Cellars not over 8 ft. deep, loading to dump wagons.	1 Light loam or sand	0 92		0 92	0 25
	1 Heavy lm. or med. clay	1 55		1 55	0 25
	1 Hardpan or cem. grav.	2 18		2 18	0 25
	2 Light loam or sand	1 50		1 50	0 25
	2 Heavy lm. or med. clay	2 40		2 40	0 25
	2 Hardpan or cem. grav.	3 43		3 43	0 25
Cellars not over 8 ft. deep, wheeling not over 100 ft.	1 Light loam or sand	1 60		1 60	
	1 Heavy lm. or med. clay	2 11		2 11	
	1 Hardpan or cem. grav.	2 96		2 96	
	2 Light loam or sand	2 11		2 11	
	2 Heavy lm. or med. clay	2 86		2 86	
	2 Hardpan or cem. grav.	4 21		4 21	
Trenches not over 6 ft. deep, throwing to one side.	1 Light loam or sand	1 19	0 79	1 98	
	1 Heavy lm. or med. clay	1 63	0 83	2 46	
	1 Hardpan or cem. grav.	2 58	1 00	3 58	
	2 Light loam or sand	1 54	0 79	2 33	
	2 Heavy lm. or med. clay	2 16	0 83	2 99	
	2 Hardpan or cem. grav.	3 64	1 00	4 64	
Trenches 6 ft. to 10 ft. deep, throwing to one side.	1 Light loam or sand	1 90	0 79	2 69	
	1 Heavy lm. or med. clay	2 22	0 83	3 05	
	1 Hardpan or cem. grav.	3 64	1 00	3 64	
	2 Light loam or sand	2 58	0 79	3 37	
	2 Heavy lm. or med. clay	2 86	0 83	3 69	
	2 Hardpan or cem. grav.	5 00	1 00	6 00	
Trenches 10 ft. to 14 ft. deep, throwing to one side.	1 Light loam or sand	2 86	0 79	3 65	
	1 Heavy lm. or med. clay	3 93	0 83	4 16	
	1 Hardpan or cem. grav.	5 00	1 00	6 00	
	2 Light loam or sand	3 80	0 79	4 59	
	2 Heavy lm. or med. clay	4 44	0 83	5 27	
	2 Hardpan or cem. grav.	7 27	1 00	8 27	

SHEET PILING FOR CELLAR AND TRENCH EXCAVATION

Kind of Work	Unit of Work	No. of Hours Carp.	M.B.F. of Lumber
Cellar not over 8 ft. deep	100 S.F.	6 90	0 15
Both sides trenches, 10 ft. deep, 2 in. x 10 ft. long.	100 L.F.	46 06	3 00
Both sides trenches, 14 ft. deep, 2 in. x 14 ft. long.	100 L.F.	62 00	4 20

TABLE VI. PAINTING

Surface	Kind of Paint	Number of Coats	Material per Unit Work	Hours per Unit Work
Plastered walls and ceilings	Varnish size, gal	1	0 17	0 45
Plastered walls and ceilings	Lead and oil, gal	2	0 45	1 05
Plastered walls and ceilings	Glue size, lb	1	0 17	0 25
Plastered walls and ceilings	Kalsomine, lb	1	5 50	0 35
Plastered walls and ceilings	White-wash, lb	2	4 00	0 67
Brick walls	White-wash, lb	2	6 00	0 67
Brick walls	Cold water paint, lb	2	10 00	0 57
Brick walls	Lead and oil, gal	2	1 45	1 13
Floors, wood	Linseed oil, gal	2	0 37	0 83
Floors, wood	Filler, lb	1	2 00	0 67
Floors, wood	Varnish, gal	2	0 47	1 17
Interior woodwork	Filler, lb	1	2 00	1 25
Interior woodwork	Shellac and putty, gal	1	0 35	0 85
Interior woodwork	Varnish, gal	2	0 45	1 90
Interior woodwork	Rub and finish, gal	1	0 10	1 17
Interior woodwork	Lead and oil, gal	3	0 70	2 37
Exterior woodwork	Shellac and putty, gal	1	0 35	0 85
Exterior woodwork	Varnish, gal	2	0 42	1 83
Exterior woodwork	Lead and oil, gal	3	0 72	2 77
Single door with transom	Filler, lb	1	1 50	1 45
Single door with transom	Shellac and putty, gal	1	0 20	1 00
Single door with transom	Sandpaper and varnish, gal	2	0 50	2 25
Single door with transom	Rub and finish, gal	1	0 10	1 25
Single door without transom	Filler, lb	1	1 25	1 20
Single door without transom	Shellac and putty, gal	1	0 13	0 85
Single door without transom	Sandpaper and varnish, gal	2	0 40	1 60
Single door without transom	Rub and finish, gal	1	0 08	0 85
Single window	Filler, lb	1	0 50	0 45
Single window	Shellac and putty, gal	1	0 09	0 20
Single window	Sandpaper and varnish, gal	2	0 20	0 70
Single window	Rub and finish, gal	1	0 05	0 33
Single window	Lead and oil, gal	3	0 26	1 08
Shingles	Stain, gal	1	3 00	0 50
Picture mould or chair rail	Filler, lb	1	1 00	0 30
Picture mould or chair rail	Varnish, gal	2	0 25	0 82
Base board	Filler, lb	1	2 00	0 75
Base board	Varnish, gal	2	0 75	2 25
Base board	Lead and oil, gal	3	0 70	3 00
Picture mould or chair rail	Lead and oil, gal	3	0 23	1 00
Iron stairs and railing	Lead and oil, gal	3		13 50
Gutters and leaders	Lead and oil, gal	3		5 00
Sheet metal roof	Lead and oil, gal	3		0 62

NOTE.—Unit of work: 1 to 19, 100 sq ft; 20 to 32 each; 34 to 39, 100 lin. ft.; stairs per flight, shingles per M; roof per 100 sq ft; gutters per 100 lin. ft.

Painting—Table VI is compiled from information furnished by a number of painting contractors who are thoroughly competent and have for many years been doing painting work in connection with all grades of building construction. No attempt has been made to carry out actual costs for labor and material as the prices that would fit conditions today might be worthless in the course of a few months. In regard to overhead and profit, if this work is to be done by a sub-contractor, there should be added at least 25 per cent to the cost of labor and material to cover his overhead and profit.

Sheet Metal Work—Table VII was prepared in the same manner as Table VI. Ten per cent has been added to material for waste in standing seam work, and five per cent for flat work for both side sheathing and roofs. Seventeen and one-half per cent has been added for corrugated iron and steel to take care of laps, cutting waste, etc. The table shows the amount of material and the number of hours required both for shop and field labor. Prices of material and labor will vary according to local conditions. At least thirty per cent should be added to the cost of labor and material to take care of overhead and profit for the sub-contractor, and in some cases it is claimed by sheet-metal workers that their overhead is fully thirty per cent and that ten per cent more should be added for profit.

Furring and Lathing—Table VIII, in the column "Spacing of Supports," for the first eleven lines, shows the spacing of furring, while lines 12 to 21 inclusive, show the spacing of wood studs or joists. The column for furring cost, in the first eleven lines, gives the weight of furring material, including the necessary

TABLE VII. SHEET METAL WORK

Kind of Material and Gage		Wood or Steel	Wt Lb per Sq.Ft.	Wt. 100 S.F. Fin. Work, Lb.	Hours to Lay One Sq. with Man and Helper
Plain steel No. 28			0 638	67 0	3 2
Black iron No. 28			0 625	65 6	3 2
Galv. steel No. 28	Plain	Wood	0 798	83 8	3 2
Galv. steel No. 26	Plain	Wood	0 925	97 1	3 2
Galv. steel No. 24	Plain	Wood	1 180	123 9	3 2
Galv. steel No. 20	Plain	Wood	1 690	177 4	4 0
Galv. iron No. 28	Plain	Wood	0 785	82 4	3 2
Galv. iron No. 26	Plain	Wood	0 910	95 6	3 2
Galv. iron No. 24	Plain	Wood	1 160	121 8	3 2
Galv. iron No. 22	Plain	Wood	1 410	148 0	3 5
Galv. iron No. 20	Plain	Wood	1 660	174 3	4 0
Galv. steel No. 28	2½ in. Corr.	Wood	0 870	102 2	3 2
Galv. steel No. 26	2½ in. Corr.	Wood	1 009	118 6	3 2
Galv. steel No. 24	2½ in. Corr.	Wood	1 287	151 2	3 2
Galv. steel No. 20	2½ in. Corr.	Wood	1 843	216 6	4 0
Galv. steel No. 28	2½ in. Corr.	Steel	0 870	102 2	4 0
Galv. steel No. 26	2½ in. Corr.	Steel	1 009	118 6	4 0
Galv. steel No. 24	2½ in. Corr.	Steel	1 287	151 2	4 0
Galv. steel No. 20	2½ in. Corr.	Steel	1 843	216 6	4 5
Galv. steel No. 28	1¼ in. Corr.	Wood	0 895	105 2	3 2
Galv. steel No. 26	1¼ in. Corr.	Wood	1 037	121 8	3 2
Galv. steel No. 24	1¼ in. Corr.	Wood	1 323	155 5	3 2
Galv. steel No. 28	1¼ in. Corr.	Steel	0 895	105 2	4 0
Galv. steel No. 26	1¼ in. Corr.	Steel	1 037	121 8	4 0
Galv. steel No. 24	1¼ in. Corr.	Steel	1 323	155 5	4 0
Galv. iron No. 26	2½ in. Corr.	Wood	0 992	116 6	3 2
Galv. iron No. 24	2½ in. Corr.	Wood	1 265	148 6	3 2
Galv. iron No. 22	2½ in. Corr.	Wood	1 538	180 7	4 0
Galv. iron No. 20	2½ in. Corr.	Wood	1 810	212 7	4 0
Galv. iron No. 26	2½ in. Corr.	Steel	0 992	116 6	4 0
Galv. iron No. 24	2½ in. Corr.	Steel	1 265	148 6	4 0
Galv. iron No. 22	2½ in. Corr.	Steel	1 538	180 7	4 5
Galv. iron No. 20	2½ in. Corr.	Steel	1 810	212 7	4 5
Galv. iron No. 28	1¼ in. Corr.	Wood	0 880	103 4	3 2
Galv. iron No. 26	1¼ in. Corr.	Wood	1 020	119 8	3 2
Galv. iron No. 24	1¼ in. Corr.	Wood	1 300	152 8	3 2
Galv. iron No. 28	1¼ in. Corr.	Steel	0 880	103 4	4 0
Galv. iron No. 26	1¼ in. Corr.	Steel	1 020	119 8	4 0
Galv. iron No. 24	1¼ in. Corr.	Steel	1 300	152 8	4 0

Kind of Material	Unit	Wt. Lb. per Unit of Fin. Work	With Man and Helper Hours Req. One Unit of Shop Labor	With Man and Helper Hours Req. One Unit of Field Labor
16-Oz. Copper				
Batten seam roof	100 S.F.	110	1 7	3 2
Standing seam roof	100 S.F.	110	1 7	2 5
Flat steam roof	100 S.F.	105	2 3	3 6
Wall covering	100 S.F.	105	1 1	4 0
Plain casings	100 S.F.	105	1 1	5 3
20-in. flashings	100 Lin. Ft.	175	0 6	4 0
36-in. box gutter linings	100 Lin. Ft.	315	6 9	24 0
Mouldings 24-in. girt	100 Lin. Ft.	210	6 9	8 0
Mouldings 30-in. girt	100 Lin. Ft.	262	8 6	10 7
Mouldings 36-in. girt	100 Lin. Ft.	315	10 3	10 7
Mouldings 42-in. girt	100 Lin. Ft.	368	12 0	16 0
Mouldings 48-in. girt	100 Lin. Ft.	420	13 7	16 0
Leaders 4x5 in	100 Lin. Ft.	166	5 7	8 0
Leaders 4x4 in	100 Lin. Ft.	150	5 7	8 0
Leaders 3x4 in	100 Lin. Ft.	125	5 7	8 0
Leaders 2½x3 in	100 Lin. Ft.	100	5 7	8 0
Leader heads	1	5	2 3	1 6
IC 40-Lb. Tin				
Batten seam roof	100 S.F.	70	1 7	3 2
Standing seam roof	100 S.F.	70	1 7	2 5
Flat seam roof	100 S.F.	68	2 3	3 6
36-in. box gutter linings	100 Lin. Ft.	204	6 9	24 0
20-in. flashings	100 Lin. Ft.	113	0 6	4 0
No. 22 Galvanized Iron				
Mouldings 24-in. girt	100 Lin. Ft.	296	6 9	8 0
Mouldings 30-in. girt	100 Lin. Ft.	370	8 6	10 7
Mouldings 36-in. girt	100 Lin. Ft.	444	10 3	10 7
Mouldings 42-in. girt	100 Lin. Ft.	518	12 0	16 0
Mouldings 48-in. girt	100 Lin. Ft.	592	13 7	16 0
Plain casings	Sq.	148	1 1	5 3
Leader heads	1	5	2 3	1 6
No. 26 Galvanized Iron				
Leaders 4x5 in. or 6-in. diameter	100 L.F.	152	5 7	8 0
Leaders 4x4 in. or 5-in. diameter	100 L.F.	137	5 7	8 0
Leaders 3x4 in. or 4-in. diameter	100 L.F.	114	5 7	8 0
Leaders 2½x3 in. or 3-in. diameter	100 L.F.	91	5 7	8 0

TABLE VIII. FURRING AND LATHING

Item No.	Class of Work Furring and Lathing	Kind of Material	Spacing of Supports, In.	Time Required to Install One Sq Yd Hrs	Furring Material In Lb per Sq Yd	Lath, Sq.Yd
1	Beams and girders	1x⅞ in. bar iron and metal lath	12	0 80	7 1	1.05
2	Beams and girders	1x⅞-in. bar iron and metal lath	16	0 66	5 7	1.05
3	Metal partitions	1x1x⅛-in. angles and metal lath	12	0 42	8 5	1 05
4	Metal partitions	1x1x⅛ in. angles and metal lath	16	0 32	6 8	1 05
5	Heavy cornice and false beam	1x⅞-in. bar iron and metal lath	12	1 00	7 1	1 05
6	Semicircular or segmental ceilings	1x⅞-in. bar iron and metal lath	12	1 00	7 1	1 05
7	Groined arches, domes, etc	1x⅞-in. bar iron and metal lath	12	1 78	11 7	1 25
8	Ceilings, furring clipped to beams	1-in. channels and metal lath	12	0 25	9 4	1 05
9	Ceilings, furring clipped to beams	1-in. channels and metal lath	16	0 20	7 2	1 05
10	Hung ceilings, including purlins, clips, etc	1-in. channels and metal lath	12	0 33	12 8	1 05
11	Hung ceilings, including purlins, clips, etc	1-in. channels and metal lath	16	0 26	10 2	1 05
	Metal Lath					
12	Ceilings and partitions stapled on wood	Metal lath and staples	12	0 12	0 05	1 05
13	Ceilings and partitions stapled on wood	Metal lath and staples	16	0 09	0 05	1 05
14	Coves and cornices stapled on wood	Metal lath and staples	12	0 22	0 05	1 05
15	Coves and cornices stapled on wood	Metal lath and staples	16	0 18	0 05	1 05
16	Beams and girders stapled on wood	Metal lath and staples	12	0 22	0 05	1 05
17	Beams and girders stapled on wood	Metal lath and staples	16	0 18	0 05	1 05
	Wood Lath				Nails	No
18	Partitions and ceilings	Wood lath and nails	12	0 11	0 10	14 5
19	Partitions and ceilings	Wood lath and nails	16	0 08	0 10	14 5
20	Coves and cornices	Wood lath and nails	12	0 22	0 14	14 5
21	Coves and cornices	Wood lath and nails	16	0 17	0 11	14 5

tieing wire and for lines 12 to 21, the weight of staples or nails per yard of lath. Five per cent has been added to metal lath to take are of cutting waste, etc. If the work is done by a sub-contractor, from twenty to twenty-five per cent should be added for overhead and profit.

Plastering—Table IX shows the amount of material and labor for one coat of various kinds of plaster work as specified in column 2. The assumed thickness is given in column 3. This thickness, of course, will vary due to the kind of metal lath, spacing of wood lath, the irregularity of the wall, etc. The amount of material as given in column 5, except for the finished coats, will vary somewhat where a different thickness is used than that specified. The same applies to the labor. In case of very irregular walls, open lath, etc., the time shown would be somewhat increased. The table, however, is intended to take care of average work. If the work is done by a sub-contractor, at least twenty per cent to the cost of labor and material should be added for overhead and profit. No blanks have been provided for carrying out the cost of labor and material, as it is thought that anyone using this table would probably draw it off on other paper. In which case, they could easily arrange for the necessary blank spaces. It will also be necessary to combine the scratch coat, brown coat and finish when plastering on lath, and brown coat and finish when plastering on masonry, in order to make a complete cost of plastering.

TABLE IX. PLASTERING

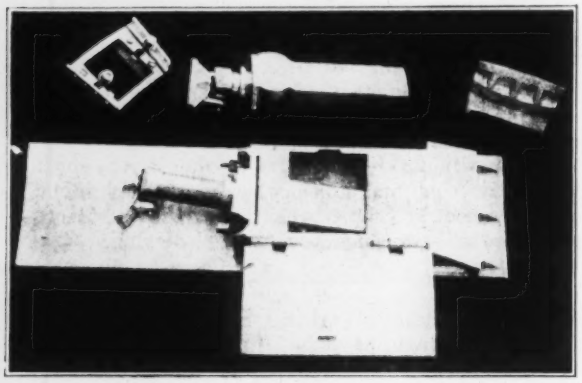
Kind of Coat	Thickness	Kind of Material	Material, per Sq.Yd.	Labor per Sq.Yd.
Scratch (1-2) on wood lath	½	Lump lime and hair, bbl.	0.0204	
		Sand, cu.yd	0 0108	0.0519
Scratch (1-2) on wood lath	½	Neat plaster, ton	0 0068	
		Sand, cu.yd	0.0108	0.0519
Scratch (1-2) on metal lath	¾	Lump lime and hair, bbl.	0.0323	
		Sand, cu.yd	0 0143	0.0571
Scratch (1-2) on metal lath	¾	Neat plaster, ton	0 0091	
		Sand, cu.yd	0 0143	0.0571
Brown (1-3)	½	Lump lime and hair, bbl.	0 0278	
		Sand, cu.yd	0 0111	0.1231
Brown (1-3)	½	Neat plaster, ton	0 0050	
		Sand, cu.yd	0 0111	0.1231
Finish—smooth—sand		Lump lime, bbl	0 0086	
		Plaster Paris, ton	0 0012	0.1067
		White sand, cu.yd	0 0003	
		Hydrated lime, ton	0 0016	
Finish—smooth—sand		Plaster Paris, ton	0 0012	0.1067
		White sand, cu.yd	0 0003	
Finish—smooth		Lump lime, bbl	0 0083	
		Plaster Paris, ton	0 0017	0 1000
Finish—smooth		Finishing lime, ton	0 0016	
		Plaster Paris, ton	0 0017	0 1000
Finish (1-3) sanded		Lump lime, bbl	0 0066	
		White sand, cu.yd	0 0091	0.1333
Finish (1-3) sanded		Hydrated lime, ton	0 0012	
		White sand, cu.yd	0 0091	0.1333
Scratch (1-1-5) Keene cement on metal lath	¾	Keene cement, ton	0 0062	
		Hydrated lime, ton	0 0062	0.0615
		Sand, cu.yd	0 0154	
		Hair, bu	0 0100	
Brown (1-1-7) Keene cement		Keene cement, ton	0 0032	
		Hydrated lime, ton	0 0032	0.1333
		Sand, cu.yd	0 0149	
Finish—Keene cement (300 lb. K. C. 100 lb. lime)		Keene cement, ton	0 0043	
		Finishing lime, ton	0 0009	0.1455
Brown—P. C. (1-4-20% lime) on brick	½	Portland cement, bbl.	0 0222	
		Sand, cu.yd	0 0118	0.1600
		Hydrated lime, ton	0 0025	
Brown—P. C. (1-3-10% lime) on terra cotta	¾	Portland cement, bbl.	0 0455	
		Sand, cu.yd	0 0182	0.1600
		Hydrated lime, ton	0 0021	
Brown—P. C. (1-4-20% lime), on terra cotta	¾	Portland cement, bbl.	0 0333	
		Sand, cu.yd	0 0175	0.1600
		Hydrated lime, ton	0 0038	
Finish—P. C. (1-3-10% lime)	½	Portland cement, bbl.	0.0156	
		Sand, cu.yd	0 0061	0.1333
		Finishing lime, ton	0 0007	
Stucco (1-1-2) pebble dash		White P. C., bbl.	0 0500	
		White sand, cu.yd	0 0067	0.3200
		Gravel, cu.yd	0.0143	

Authorize Higher Working Stresses in Steel Framework of New Buffalo Hotel

By vote of the city commission of Buffalo the use of working stresses of 18,000 lb. per square inch has been authorized for the steel framework of the new Statler Hotel in that city. As the structure was originally designed by George B. Post & Son of New York City, architects for the owner, the Buffalo building code was followed literally, the beams being designed for an extreme fiber stress of 16,000 lb. per square inch and the columns for a flat unit stress of 12,000 lb. per square inch, as allowed by the code for columns shorter than 90 radii. The steel frames so designed involved about 8,000 tons of steel. E. M. Statler, the owner, thereupon made application to the city commission that the code be suspended for this particular building and working stresses one-eighth higher be sanctioned for the design. The request was made with the approval of W. J. Thomas, structural engineer to the architect, and was endorsed by the building code revision committee of Buffalo. This committee's recommendation was subsequently adopted by the city commission. The steel framework has therefore been redesigned for beam stresses of 18,000 lb. per square inch and a column loading of 13,500 lb. per square inch, instead of 1,600 lb. and 12,000 lb.

Pivoted Jacks to Prevent Rotation of Tunnel Shields

TO ELIMINATE difficulties in shield tunneling from rotating of the shield a new jack arrangement has been developed by W. B. Updegraff, of the Watson-Stillman Co., New York and patented. It is now ready for practical application in that company's shield-jack equipments. Hitherto no satisfactory means have been available to the engineer engaged in driving a tunnel through soft ground by the shield method for dealing with the tendency manifested by many shields to rotate around the longitudinal axis as the tunnel is driven ahead. Since working platforms, doors and other internal structures of the shield are thrown out of level by the rotation, the tunneling operations are made noticeably more difficult, expensive and dangerous. With an elliptical section of tunnel, rotation would, of course, be wholly unpermissible, and the chance that it might occur has been urged as an effective reason against the adoption of such a section when proposed as a means of improving the clearance or strength conditions of tunnels. The new arrangement is exceedingly simple, consisting of nothing more than mounting the jacks in such a way that they can be adjusted in a tangential plane through 10 or 15 deg. either side of the front-to-back erection. When a jack is thus "angled," it will



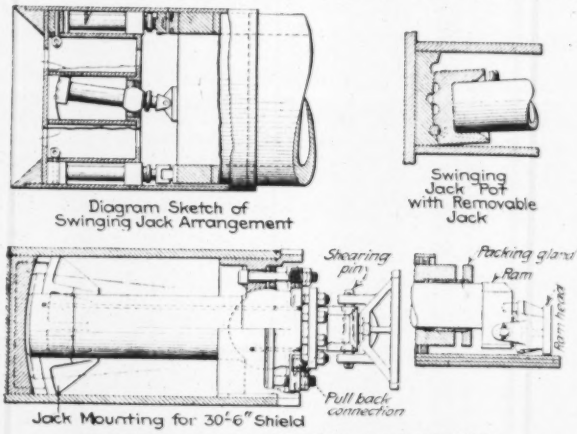
MODEL OF PIVOTED JACK, ASSEMBLED AND UNASSEMBLED

obviously exert a rotative moment on the shield as it is operated to force the shield ahead.

One or all the jacks of a shield so equipped may be angled, in different amounts, and the rotative forces thus adjusted to suit the requirements of the moment. By proper manipulation, moreover, it is possible to use the jacks to exert a vertical force (lifting or depressing) on the nose of the shield, or a lateral force to right or left, to help in guiding the shield. However, the primary function of the pivoted-jack is to deal with rotation.

A diagram sketch of the pivoted-jack arrangement is shown in the upper part of the drawing, which represents a sectional plan view of a shield with the lower jack set at an angle. There is a pivotal mounting at the rear end of the jack, and a circular-arc block bearing at the front, with provision by registering notches and a locking pin for setting the jack at various angles along the arc. The detail sketch at the right shows a separate jack pot which constitutes the shoe of the swinging part, the jack being set into the pot as a separate member, for removal, repair, or replacement.

Adaptation of the design to a working scale is shown in the lower part of the drawing, taken from a working drawing of the jack mounting for a shield of 30 ft. 6 in. diameter. This shield is to be equipped with 31 jacks, each of 36-in. stroke and 216 tons capacity. In this design the arc block is detailed with



PIVOTED JACK MOUNTING AS DESIGNED FOR 30-FT. SHIELD

lateral wings to form the jack pot, and the jack merely butts against the cylindrical face of this block, without locking arrangement. Two bolts, which hold the head of the jack in its spherical socket, control its angular setting and hold it in position. By removing these two bolts the jack may be pulled out for inspection or repair. Felt packing between the main socket plate and its cover plate prevents the entrance of dirt or grout into the jack compartment, and the head of the jack with its bolts, etc., may be protected by clay mudding.

An important element of the design is the selfadjusting bearing shoe at the outer end of the ram. The shoe swings on the ball end of the ram, and is held by a pin whose seating hole in the jack head is slotted to taper form to permit the head to swing in a plane tangential to the tunnel while yet resisting the twist that would develop as a result of the offset between the shoe and the ram center, when the jack is operated at an angle.

Work Begun on Calcutta Dock

Work has begun on the King George's dock in Calcutta, India, according to recent issue of *Commerce Reports*. Owing to the nature of the soil, it is proposed to construct both entrances and the dock itself by sinking wells or monoliths. The first section of the work will consist of the entrance lock and dry docks and the northern portion, comprising altogether 11 berths, arrangement being made to use the first 5 of these as soon as they are ready, probably by 1927. It is estimated that each year's work will involve the utilization of large quantities of brick, lime, cement, steel, and stone, and that 13,250,000 cu.ft. of excavating will be done, employing some 10,000 laborers. The dock system will consist of a basin and two long arms, each about 4,500 ft. long by 650 ft. wide. When complete the water area of the dock will be about 190 acres, the length of the quay wall about 25,000 ft., and the number of berths 35. The two dry docks will measure in all 1,190 x 80 ft. Thirty-three of the berths will be equipped as import or export berths.

Unified Terminal Operation Held Essential to Economy

Abstract of paper by George H. Kimball, consulting engineer, Pontiac, Mich., read before Buffalo Section, Am. Soc. C. E. April 5, 1921.

UNIFIED operation of all terminal facilities, a general classification and clearing yard, exterior connecting lines for diverting through freight movements, and local yards, for holding city and industrial freight ready for delivery, must finally control the terminal situation in any great city if industrial growth is to go on unchecked and service be performed with economy and dispatch. Any discussion of the subject must be largely general since its ramifications reach out into details varying with circumstances. Present conditions are a discredit to all concerned, but the railroad service holds the engineering and operating ability to work the necessary transformation. We have come to a time of forced readjustment in railroad affairs, when to stand still is impossible, even though our future course is far from clear, but the great need today is for an increase of capacity together with more prompt movement and greater economy.

Line Movement Slowed Down

The terminal problem has emerged following the growth in tonnage density which has doubled about every ten years. Under these conditions, the *line movement* slowed down in spite of the rapid increase in the capacities of cars and locomotives and the reconstruction of tracks and structures, so that the proportionate capacity from increased facilities was not fully realized. Since the steam locomotive, speaking broadly, has reached its limits of economy and efficiency and imposes limitations on the whole operating system, electrification may be considered the only ultimate solution of present railroad difficulties. Electrification of terminals will naturally come last, but the requisites of economical terminal operation apply either with steam or electricity. If we propose to pour at least twice the present volume of tonnage through these terminal "bottle necks," the whole operating system, at least so far as train movements and things related thereto are concerned, must be modified to secure the full benefits of possible economies. There is no doubt at this time that these possibilities are very great. I feel sure that this problem will have to be met before we can fully prepare for it.

As a result of a year's investigation of the Buffalo freight terminal situation in 1904, four things were found to be necessary as prime factors to make possible the solution of the problem or any other similar terminal problem: Unification of all terminals and terminal facilities as to operation, but not necessarily as to ownership; provision for a general classification and clearing yard of proper location and conformation; connecting exterior lines for the purpose of diverting all through freight movements around the congested areas, and local outer yards for city and for industrial freight. Within the Buffalo terminal area lie a crowded network of main lines and freight yards, with frequent crossings at grade, forming a congested area wherein economy or efficiency under present methods and conditions is impossible. The facilities of each corporate ownership are operated as a unit in spite of their interrelation under heavy volume of interchange business. Independent switching involves both duplication of facilities in track, equipment and service, with overlapping and delay at many critical points.

The principle of unification was held to include, in addition to the plan of unified operation under one management, freedom of access to all terminal territory, thus placing all railroads and all shippers on an equal footing so far as charges for the same or similar service were concerned. The intent being that shippers located on the rails of any one railroad should be free to receive and forward freight via any railroad route they might choose. So far as possible to determine, these principles were then formulated for the first time.

The Cost of Wasteful Competition

The chief difficulty in the way of a better order of things is in the unwillingness of the railroad corporations to co-operate for the common good by making unification possible. Past practices of refusing through rates and through bills, etc., have been stopped generally through legislation. So will unification in the operation of terminals come about. Unified terminal operation was put in practice during the period of Federal control, and in spite of the handicap at that time, noticeable results were produced. Since the return to private operation, however, terminal methods have sagged back to the old order of things. Still the problem presses everywhere, and is a sink-hole of expense, limiting business and industry in every city and port of the country.

Unified operation permits close co-ordination of facilities and service, and the use of the best possible methods. It prevents overlapping and interference in switching movements, and also reverse and duplicate movements. The general clearing yard must be so located that practically all of the freight traffic to be handled can pass through it, combining receiving, classification and forwarding facilities with large capacity for gravity switching, and for engine and car repairs. The situation will be further helped by the complete classification of traffic as to *trains*, as well as a more complete classification of the trains themselves.

In Extent Terminal Is Adequate

With the co-ordination of these facilities must come modification and re-arrangement of all other details and methods. Present track facilities within the congested limit of the city of Buffalo are doubtless more than sufficient in their *extent* for present and future needs, but they must be rearranged and modified as to use. It may be anticipated that extensive terminal trackage and large areas of valuable property now in use in railroad service will be released for other purposes or will be held for future expansion. Freight stations can be brought up to date by building double-deck freight houses, by the use of electric trucks with trailers, and the further use of appliances for mechanical handling which have proven their value but lack general application.

The question of store-door delivery of city freight is now under consideration by the railroad executives, with prospect of its adoption. There is no good reason why city house-freight arriving during the night and early morning should not be off the floor and in the hands of consignees at an early morning hour, or be sent to storage on consignees' account. The growing use of containers is also a valuable factor.

Notes on English Bituminous Road Practice

Slag Preferred for Tar Macadam—One-Coat and Three-Coat Systems Employed—Asphaltic Macadam Surface Increasing in Favor

By A. Dryland
County Engineer of Middlesex, England

THE most approved form of tar-macadam construction used in England today is undoubtedly that in which blast-furnace iron slag is used as an aggregate. For some years a controversy was carried on as to the relative virtues of granite and slab for the purpose, but there would be few found today who would deny the superiority of slag both in wearing and waterproofing capacity.

Among granites most success was attained with those generally deemed of a second- or third-rate character as road metals. The reason is probably to be found in the fact that the harder and denser the stone, the less the porosity. The difficulty chiefly found with granite was to combine sufficient matrix to produce a waterproof coating without making it so susceptible to summer heat as to allow of movement in the material.

Blast-furnace slag, however, contains a large number of small pin-holes and slight honeycomb indentations which in practice seem to give it just that porosity necessary to retain tar in the ideal quantity. The individual pieces of aggregate often vary in density and hardness, and a considerable amount of crushing takes place, resulting in the coating forming a dense cake. With granite aggregates, on the other hand, the individual stones do not crush and bind together in the same way, but tend to move and rub off the tar coating.

Slag Tar-Macadam

Slag tar-macadam is made by admixture with refined tar when the material is quite dry. Various makers have their own particular grades of tar, but the author has found refined tar meeting the requirements of English Road Board specification No. 1 quite satisfactory. The quantity of matrix varies from about 9 gal. per ton of aggregate of the coarsest grades to 11-12 gal. for the fine material used for topping.

There are two methods of laying mainly used in this country: The first—more particularly used to produce coats not more than 3 in. in consolidated thickness—is by laying a mixed gage material running from 2½ in. down to ⅜ in. gage, of which about 60 per cent is 2½ in. This is laid in one coat with, perhaps, the addition of a light sweeping of ⅜-in. tarred material to fill interstices before completing rolling.

The three-coat system is usually adopted for 4-in. consolidated coatings on heavy traffic roads. A base coat of 2½-in. gage is laid to a consolidated thickness of 2½ in.; upon this is spread a layer of 1½- to ½-in. graded material rolled down to about 1¼ in., and thereupon, before consolidation is perfect, is laid a thin layer of ⅜- or ½-in. material.

Coatings so constructed have had to date a life of 9½ years with trifling repairs, except an annual summer dressing of tar and chippings on important arteries, such as the Brighton and Portsmouth roads adjoining the London boundaries.

In the secondary streets of the metropolis and, indeed, on some of those of the first class, and on many important town streets and heavily trafficked arterial routes, the bituminous or asphalt macadam form of road surface is finding increasing favor. The usual practice is to lay a base coat of tar-macadam or asphalt-macadam, varying from 2½ to 3 in. when consolidated according to the nature of the highway, and imposing thereon 1¼ or 1½ in. of asphalt.

The base coat is generally made of either granite or limestone, 1½ down to ⅜ in. gage, but in many cases the old waterbound macadam surface is taken off the road to a depth of about 3 in., and the material is passed through a drier combined with a fan to extract the very fine dust. Apart from this dust the whole of the material is retained for use and, as the author can testify, produces a very satisfactory base coat when heated and mixed with a pitch matrix composed of about 82 per cent Road Board specification soft pitch and 18 per cent heavy tar oils.

With clean granite or limestone aggregates refined tar is sometimes used as a matrix, but this involves delay in executing work, as the tar-macadam requires 7 to 10 days to get thoroughly hard. This method is only pursued where speedy opening to traffic is not a necessity.

For the heaviest class of work about 6 per cent asphalt-cement binder is used and has the advantage, which is also attained by the pitch matrix before referred to, of allowing the immediate superimposition of an asphalt coating.

The English practice which has the greater vogue for surface coating is composed of Trinidad bitumen and graded sands laid to a consolidated thickness of 1¼ or 1½ in. to the following specification:

Trinidad bitumen epuré, 75 per cent; heavy petroleum residuum oil, 25 per cent; penetration at 77 deg. F., 55 to 65, according to location and extent of traffic.

Soluble bitumen content, 67 per cent; mineral matter, 28 per cent; specific gravity, 1.27.

Sand aggregate, free from clayey matter and giving about 20 per cent passing 80 and 100 meshes combined, and not more than 10 per cent passing meshes below 40. Intermediate meshes are not considered very important.

Filler, 15 per cent of portland cement or other equally fine inert material.

Proportion, 7.3 cu.ft. graded sand; 120 lb. portland cement; 150 lb. asphalt cement, penetration say 60 at 77 deg. F.

TYPICAL ANALYSIS

	Per Cent
Bitumen soluble in CS_2	12
Aggregate passing 200 mesh	16
Aggregate passing 100 mesh	12
Aggregate passing 80 mesh	10
Aggregate passing 50 mesh	40
Aggregate passing 40 mesh	4
Aggregate passing 30 mesh	3
Aggregate passing 20 mesh	2
Aggregate passing 10 mesh	1
	100

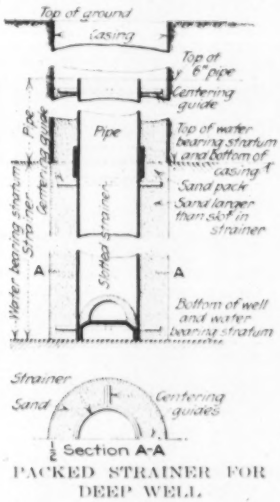
The surfaces produced by the foregoing methods are very durable in this variable climate and the maintenance for the first 10 years is very small. The only objectionable feature is a tendency to "rippling" or small corrugations which the author believes to be

largely due to the plasticity of the material in its early life and to temperature changes. This corrugation does not appear to increase materially with age or to cause undue wear or deterioration, but it is, nevertheless, an annoying feature to the experienced observer and is, in some cases, sufficiently marked to be apparent to a traveler in a small or light car. If our American friends can tell us how to exorcise this "ghost" they will earn our lasting gratitude.

Deep Wells with Packed Strainers to Exclude Sand

By F. D. Yeaton
Assistant Engineer, Chicago, Milwaukee & St. Paul Ry., Chicago, Ill.

DRILLED wells so constructed that they will not become partly filled with sand have been used with success by the Chicago, Milwaukee & St. Paul Ry., and are of importance for the reason that railroads and municipalities experience considerable trouble each year with bored or drilled wells partially filling with fine sand. The flow into the well is diminished, and if the sand is very fine it is drawn up by the pumping machinery, damaging the working barrel, causing wear of the pump leathers and reducing the efficiency of the pump.



PACKED STRAINER FOR DEEP WELL

It is common practice to clean out sand filled wells periodically, but to do this the pumping machinery must be removed. If the well is shallow the sand can sometimes be blown out with compressed air. For deeper wells it is necessary to use a sand bucket or other means for bailing out the sand, which is a slow and expensive process and may cause damage if there is a brass strainer or screen in the well.

For sand-proof construction, the well is drilled and cased to the bottom of the water-bearing stratum. A strainer with closed bottom, the diameter of which is about half that of the casing and the length of which is equal to the depth of the water-bearing stratum, is then lowered by means of a line of pipe which may be of the same diameter as the strainer, or smaller. The strainer is held in place by centering guides and a coupling at the top enables the pipe to be detached after the strainer is set.

The space between the strainer and casing is then packed with sand of larger size than the slots or openings in the strainer, after which the casing is pulled back to the top of the water-bearing stratum. Sometimes it is advisable to leave a short length of pipe attached to the top of the strainer, as shown in the drawing, and the drop pipe of the pump can be inserted into this pipe to advantage. Trouble in raising the casing of a well more than 200 or 300 ft. deep may be avoided by the use of a temporary inside casing which is removed after the strainer and packing have been placed.

When the work is finished the well is developed by pumping at different rates, slowly at first. This accelerated pull or draft will remove any fine sand that might have lodged near the strainer and will bring the stratum around the well to a stable condition, offering free passage to the water. Theoretically each grain of fine sand removed from the water-bearing stratum has been replaced with a grain of sand larger than the slots in the strainer. This coarse wall or filter holds back the fine sand, preventing the breaking down of the water-bearing stratum and the possible failure of the well. A large diameter is advisable, but a 12-in. well with 6-in. strainer will give good results.

In one case a 265-ft. 12-in. well provided with a 6-in. sand-packed strainer 20 ft. high, with No. 14 screen, yields 250 gal. per minute, although several earlier wells without sand-packed strainers furnished only 75 gal. when drilled and later became filled with sand so that their capacity was reduced to about 40 gal. per minute.

This method of placing a sand or gravel filter around a strainer is not new and is mentioned in Flinn, Weston & Bogart's "*Waterworks Handbook*." (p. 239). More care in the finishing of the well in the water-bearing stratum would save the expense of cleaning out sand, replacing damaged strainers and maintaining worn pumping machinery.

Broad Powers for Sacramento City Engineer

Under the new commission-manager city charter for Sacramento, Cal., that will go into effect on July 1, the city engineer has broader powers, or at least powers much more specifically defined than is usually the case. Before citing these it may be mentioned that the charter provides that the city engineer "shall be a civil engineer of not less than five years' practical experience as such." His powers and duties are thus defined.

Sec. 61. The city engineer shall be ex officio superintendent of streets. He shall have charge of the planning, opening, construction, paving, maintenance and repair of streets, boulevards, alleys and public ways. He shall have supervision over the sewers and sewage system, the crematory, the corporation yard, the cleaning and sprinkling of streets and the levees of the city. He shall have charge of the city water-works and mains and of any filtration plant operated by the city. He shall have charge of the construction, maintenance, repair and operation of all public buildings belonging to or used by the city, all wharves, docks, chutes, ships, quays and waterfront property, of the construction and maintenance of fire and police alarm systems, of all buildings and automobile mechanics and machinists in the employ of the city and the enforcement of all rules and regulations pertaining thereto, of the inspection of all electric wires for furnishing heat, light or power, and of the wiring of all buildings hereafter erected in the city and of the inspection of buildings and the issuing of permits for building operation in accordance with the rules and regulations which may be prescribed by ordinance. He shall also perform such other duties relating to his department as may be required of him by the city manager.

In addition to the foregoing powers and duties of the city engineer, the Sacramento charter specifically provides that he "shall cause to be made a full and complete set of water system records consisting of maps, plats, notes, and other records of the city water pipe system," specifying further details as to what the records shall include. Further duties of the city engineer, subject to the approval of the city manager, will be "to furnish to any department of the city such service, labor and materials as may be requisitioned by the head of such department."

Concrete Sea Wall Poured in Block Sections by Tremie

Position of Suction Pipes for United Electric Plant on East River Makes Special Formwork Necessary All Concreting Plant on Traveler

IN BUILDING the new steam power plant of the United Electric Light & Power Co., on the East River at 138th St., New York City, a departure from the usual design is found in the use of individual suction pipes for each generating unit, instead of a single suction tunnel. The position of these suction pipes—the ends of which extend well into the water at low tide—in the discharge tunnel bulkhead, extending as they do through the bulkhead at an approximate angle of 49 deg. from the horizontal, lead the contractors, the P. J. Carlin Construction Co., to devise a system of pouring the bulkhead, or sea wall, in sections, three distinct operations being necessary to complete it. The position of the discharge pipes in the inside wall of the tunnel also made special formwork necessary, though

FIG. 1. LOWERING OF BLOCK FORMS—ONE BLOCK IN PLACE

the spectacular work was done in concreting the sea wall. On the sea wall the method followed comprised the pouring of block sections between suction pipes first, then pouring closure sections to the full wall height leaving only space enough for setting the pipes, and concreting by hand around and above the pipes.

The new plant is to have an ultimate capacity of 280,000 kw., though the initial installation is to be half this. It comprises a turbine room that runs parallel to the river front an approximate distance of 370 ft., its line of columns on the front face resting on the sea wall. Behind the turbine room is a boiler house of the same length, these two buildings, built practically as a unit, having a width of 320 ft., and a height of 120 ft. The initial installation of generating equipment will consist of two 35,000-kw., 25-cycle, three-phase, 11,400-volt turbo-generators, and two 35,000-kw., 60-cycle, three-phase, 13,200-volt turbo-generators. The steam end of the 25-cycle units will be of single-cylinder type, while the 60-cycle units will have tandem compound reaction turbines. Separated from the boiler house by a narrow passageway are being constructed the electrical galleries—a reinforced-concrete building of seven stories with outside dimensions of 105 ft. and 112 ft. A wharf in front of the sea wall, and coal and ash

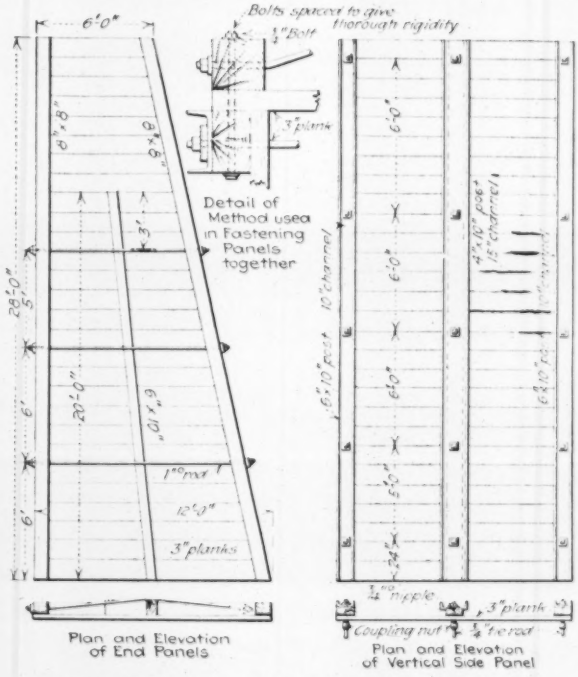

Bolts spaced to give thorough rigidity
Detail of Method used in Fastening Panels together
Plan and Elevation of End Panels
Plan and Elevation of Vertical Side Panel

FIG. 2. DETAILS OF SPECIAL FORM CONSTRUCTION

handling and other mechanical equipment will complete the installation.

The site of the entire turbine room was practically all under water and to obtain the most economical results the work was designed in such a manner as to minimize the amount of concrete to be poured under water. The plan consisted in building a sea wall along the easterly building line of the turbine room parallel to the river, and return walls on the north and south building lines, extending inshore where the high water line reached solid rock bottom. All these walls were parts of the completed structure. On account of the openings in the discharge tunnel these walls could not be made continuous, and where the breaks occurred construction gates made of timber had to be inserted in slots left to receive them.

The sea wall, as is indicated in Fig. 5, forms part of the outside wall of the discharge tunnel. It has a top width of 6 ft. and a bottom width of 12 ft. From its outside face to the tunnel center line is 21 ft. 9 in.—the tunnel having a width of 11 ft. 6 in.—and to the center line of the discharge pipes 32 ft. 3 in. The tunnel is constructed with each end open to the river.

At the site of the sea wall before dredging, there was an average depth of 10 ft. of water at low tide. In

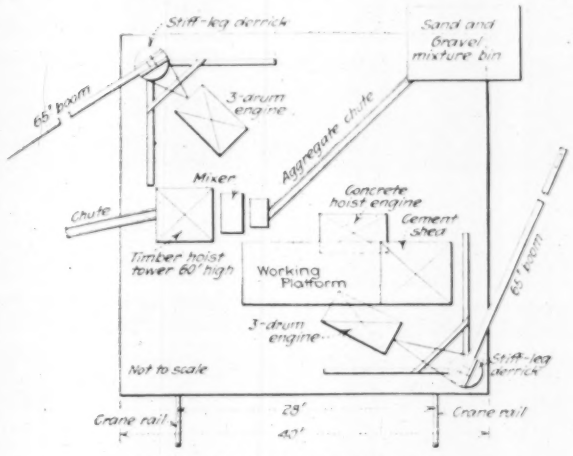


FIG. 3. PLAN OF TRAVELER

order to secure a solid rock foundation for the wall, it was necessary to dredge a depth of from 12½ ft. to 17½ ft. The character of the material dredged was Manhattan schist. Considerable drilling and blasting was also necessary, being done from a drill boat, holes being charged from the drill boat through a casing. The cleaning of the bottom was done from a scow equipped with an 8-in. suction pump and a 3-in. jet pump. The material pump was handled by a derrick directed by a diver who also operated the jet pump, moving the fine material toward the suction, and loosening the material generally. Boulders and other material too heavy for the suction, were raised in buckets.

After the dredging had been done, the block forms, which had been constructed simultaneously with the preparation of the foundation, were lowered into place. The block forms, as shown in Fig. 2, were built essentially as follows: The end panels, 6 ft. wide at the top and 12 ft. wide at the bottom, were built first. They were made of 3-in. planks, with an 8 x 8-in. post extending at either side of the panel the full wall height—28 ft. Midway between the side posts was placed a 6 x 10-in. timber extending from the bottom of the panel upward 20 ft. This timber was fastened with its 6-in. face against the planking, and over it and through the side posts were run three ¾-in. iron rods, trussing the panel to give it adequate stiffness. The rods were spaced 6 ft. apart, the first being 6 ft. from the bottom of the panel. The side panels were also built of 3-in. planks, 6 x 10-in. timbers being placed flat at the sides with a 4 x 10-in. timber at the center. Ten-inch channels were secured to the side timbers and a 15-in. channel to the center timber to give additional stiffness and to add weight to the form so that it would sink easily. End and side panels were bolted together through the side timbers of the respective panels.

In order to make the entire form rigid, ¾-in. nipples were passed through the channels and threaded into coupling nuts on the inside of the form. To these coupling nuts were threaded ¾-in. tie rods set into the forms 5 ft., 6 ft., 6 ft., and 8 ft. apart, respectively, beginning at the bottom of the form, the first rods being 2 ft. from the bottom. In stripping the forms the tie rods with the coupling nuts necessarily remained in the wall. The block sections were set on 42-ft. centers for almost the entire length of the wall—400 ft. The intake pipes were sixteen in number set in pairs on 13-ft. centers, giving a distance of 42 ft. between the centers of each two pair of pipes.

After the dredging and some cleaning had been done, the block forms were lowered into place and braced to the traveler trestle. As the river bed was not level, the forms were trued up after lowering and continuous 2-in. planks were nailed to the bottom of the form on the inside so that the ends of the planks followed the contour of the river bed. With the form thus sealed bags of a sand and gravel mixture were lowered to divers who placed them on the outside of the forms to seal the bottom and secure the planking which patched the bottom of the form. Bags were generally placed well above what patching work was necessary.

FIG. 4. SETTING THE CLOSURE FORMS

The block forms were then filled with concrete with a tremie.

In order that concreting might be done on any section of the wall as desired, the entire concreting plant was set on a traveler operating over a 28-ft. gage track which was sustained by a 12-in. timber trestle with bents on 12-ft. centers. This traveler, as shown in Fig. 3 was 40 ft. square. On opposite corners were placed stiff-leg derricks, each with a 65-ft. boom and each operated by a three-drum engine. On the front of the traveler was placed the concrete hoist tower, guyed to the traveler, and 60 ft. in height. The mixer was directly behind the hoist tower and aggregate was chuted to the mixer from an overhung material bin on one of the rear corners of the traveler. Over one of the derrick engines was built a platform that supported a cement shed. Behind the mixer was the hoist engine.

The tremie was supported from the end of the front derrick boom by heavy cables. The traveler was placed so that the distance from the derrick to the outer face of the sea wall was about 45 ft. Cables from another boom supported the two 30-ft. sections of chuting extending from the hoist-tower toward the tremie. The chuting was in two 30-ft. and one 10-ft. length, the

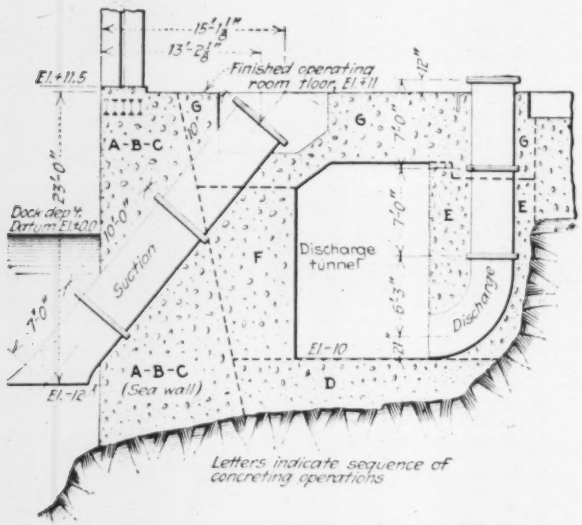


FIG. 5. CROSS-SECTION OF TUNNEL AND SEA WALL SHOWING SEQUENCE OF CONCRETING OPERATIONS

10-ft. length resting with its outer end on the tremie hopper platform. The other derrick was used for the transference of materials from stock piles to the traveler.

The tremie pipe was spiral riveted with a ½-in. plate 12 in. high riveted to the end to give it sufficient stiffness. It was 12-in., inside diameter, and was secured at its top by a cast-iron flange to a hopper made of No. 8-gage sheet iron. The hopper flared from this flange on a 45-deg. angle to a 4-ft. square 3 ft. high. Around the mouth of this hopper was built a wooden platform with a hand rail for the use of workmen. The platform was fastened to the tremie with 3½ x 3½-in. angles. The capacity of this hopper was approximately 2 cu.yd. above the tremie pipe.

In concreting, the work was started with the bottom of the tremie resting on rock. Concrete was then chuted from the tower down the tremie until the hopper contained about 1½ cu.yd. of material. The tremie was then raised slightly, the signal to raise and lower being given by a system of red and blue lights showing in the derrick engine room and running to a double knife switch on the hopper platform. Successful concreting required that concrete always be kept in the tremie hopper. Concrete used was of a 1:2:4 mix, the aggregate being dredged gravel—screened, proportioned, and mixed before being barged to the site. After all the block sections had been poured the forms were stripped permitting the closure sections to be put in while the blocks were installed farther along the wall. There were 30,000 cu.yd. of concrete in the wall and tunnel, and 25,000 cu.yd. of rock were taken from the site.

As there was a clear span of 29 ft. 3 in. between blocks, the forms for the closure sections were built in two 16-ft. sections, the overlap serving as a guide in fitting the closure forms over the blocks already poured. These forms were built up in much the same manner as were the block forms, 6 x 10-in. timbers being used at either side of the panels, with 4 x 10-in. timbers and 15-in. channels in the center of the panels. The same system of tying the panels together was employed as in the construction of the block forms. The two 16-ft. sections were bolted together in place by divers. Inasmuch as the closure sections were particularly heavy, they were generally built up on stringers extending from the shore to the block sections. The derrick had then only to tip them into place.

The cast-iron intake pipes were set in the wall at an approximate angle of 49 deg. from the horizontal. They are in three sections, of 7, 10 and 10 ft. respectively, of an inside diameter of 54 in. and a thickness of 1½ in. The position of the flanges made concreting additionally difficult.

After the pipes were set in the wall and braced, the spaces between the pipes and the concrete were filled by divers in the following manner. Braces were set vertically to hold 1-in. sheathing cut to fit around the pipes and cover the opening. After the boards had been placed

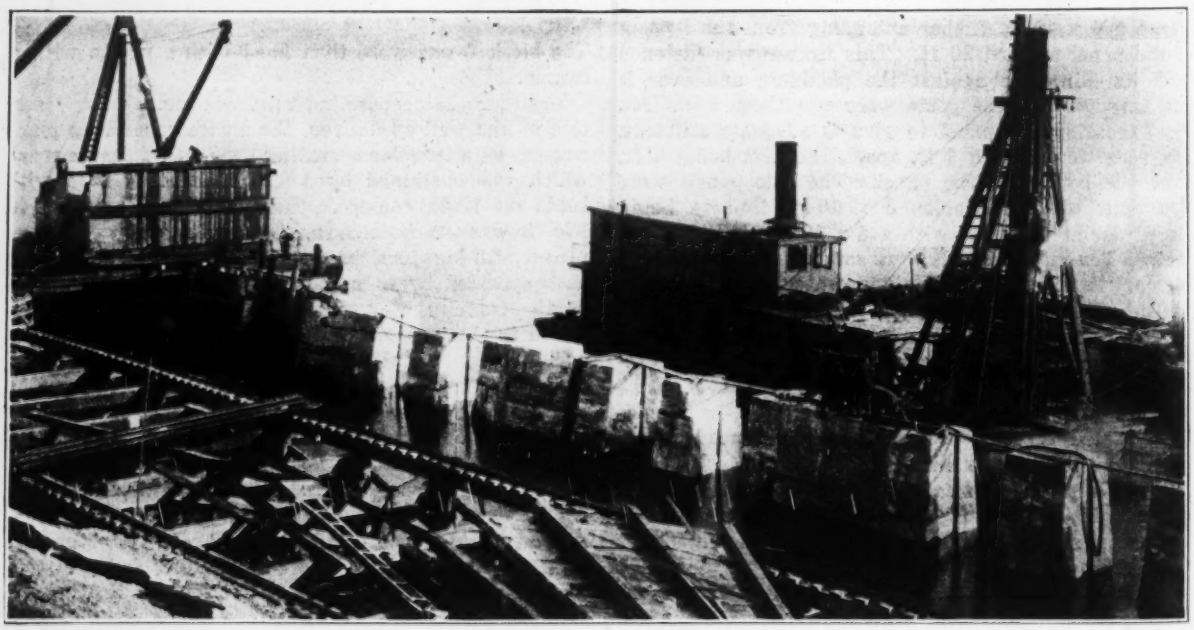


FIG. 6. CLOSURE SECTIONS OF CONCRETE SEA WALL IN PLACE

FIG. 7. WALL AND TUNNEL FLOOR COMPLETE

and wedged securely, the diver emptied into the space bags of concrete of a stiff mix. This hand method of pouring was carried on until the concrete was above the water line. As the bottom of the intake pipes was about 12 ft. below mean low water (—12), and the range of tide is about 7 ft. at the site, most of the concreting that formed the third operation to complete the wall was done by the hand method. The finished elevation of the wall was generally +11, variation being made where column grillages for the superstructure were to be placed.

After the sea wall had been poured entirely, the bulkhead gates at either end were inserted. These gates were built of heavy timbers strengthened by posts and channels, and were set as snugly as possible into the channel guides in the sea wall and the retaining walls on shore. The joints between the bulkhead gates and channel guides were then caulked. With a 10-in. electric pump the water was pumped from behind the sea wall, no leaks whatever being found in the wall.

After the area behind the sea wall had been excavated to solid rock, a slab of concrete was put in to an elevation of —10, forming the floor of the discharge tunnel and the foundation of the outside tunnel wall. The next concreting operation was on the shore wall of the tunnel through which the discharge pipes ran. One discharge pipe was placed at either end of the tunnel wall, seven pairs being set between the end pipes, a clear span of 26 ft. being the distance between each two pairs of pipes. The concreting work on the shore wall of the discharge tunnel was done much in the same manner as that on the sea wall. Sections between each two pairs of discharge pipes were poured first. The two lower sections of the discharge pipes were then set in place, and the third, or top, section of the discharge pipe, was bolted on to the pipe which was already in place.

The third concreting operation on the discharge tunnel itself was carrying the sea wall side of the tunnel wall up the full height of the tunnel. The concrete slab over the tunnel and both walls was then poured to its full thickness and width. The sequence of operations in pouring is shown in Fig. 6, which also furnishes a typical cross-section of the completed tunnel. The position of the intake pipe made it necessary to bevel the discharge tunnel roof. The wall was started Nov. 1, 1920, and finished Jan. 1, 1921.

The P. J. Carlin Construction Company has the contract for the construction of the sea wall and discharge tunnel. Post & McCord are the contractors for the structural steel and the U. S. Structural Company for the superstructure. Thomas E. Murray, Inc., are the engineers for the design and construction of the entire plant. E. A. Herrick is the general superintendent for the contractor and S. Kent is the contractor's engineer on the job.

How To Use Crayons for Tinting Charts and Diagrams

COLORED crayons can be used by draftsmen to tint charts and diagrams with greater ease and with nearly as good effect as water colors will produce. Julian Hinds, engineer, U. S. Reclamation Service, tells how to secure the best effect in the February *Reclamation Record* (Washington, D. C.) as follows:

The crayon should be applied lightly to the paper and spread with gasoline applied with strips cut from an ordinary blotter or with a fairly stiff color brush. The blotting paper may be rolled or folded to give greater stiffness. Absorbent cotton twisted around a sharpened stick also makes an excellent spreader. For small or narrow areas a soft splinter, or a match stick, sharpened to a blunt point may be used. For large areas an artist's stub will be found convenient. Some men prefer to flow the gasoline on rather freely, rubbing the color very lightly; others prefer to use only enough gasoline to moisten the spreader.

Crayon colors have a distinct advantage in that they can be applied to tracing cloth. For this purpose, a blotting paper or cotton spreader should be used with a minimum amount of gasoline. If the gasoline is flowed on too freely the color may be entirely removed.

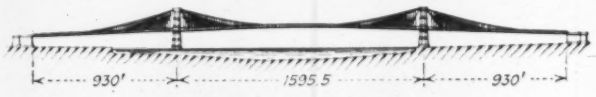
In applying the color to the paper, it is important that the crayon be rubbed in lightly. If pressure is used, the pigments are rubbed into the paper and will not spread readily. Deep tones should be obtained by continued light rubbing. The colors are much stronger after spreading and care should be used not to apply too much pigment.

After the application of the gasoline, the color should be dead flat, uniform and perfectly transparent. Color applied in this way does not readily rub off, but unless the paper is very porous may be removed with a soft rubber eraser.

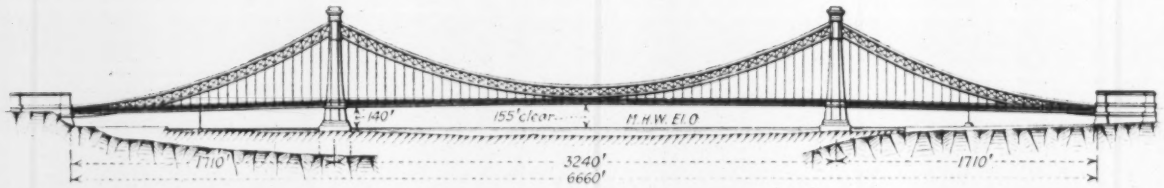
An inexperienced man will get much more artistic results with gasoline and crayon than with water color, and an experienced man will get good results with a much smaller expenditure of time and patience. For small intermittent jobs, crayons possess the advantage of being always ready and requiring no paraphernalia. Also, shades applied at different times are easily matched. Wax crayons probably give best results.

Planning for Hudson River Bridge at New York City

WITHIN the last six months active work has been resumed on the old project for bridging the Hudson River at New York City. Increasing pressure of traffic demands, both railway and highway, has resulted in steady growth of the demand for a river crossing of large traffic capacity, which led last November to the formation of a committee comprising members of a number of strong financial groups, for carrying out a careful study of the project. Plans for a railroad bridge in the neighborhood of 23d St. had been worked out about twenty-five years ago, but the change of conditions since then was believed to call for a restudy of the entire project, including both traffic and structural phases. The committee has since been succeeded by the Hudson River Bridge Corporation, incorporated in February, with George A. Post as president, Thomas H. Simpson and George F. D. Trask as vice-presidents, and Fulton McMahon as secretary. A large engineering organization has been built up, which is at work under the direction of Gustav Lindenthal, chief engineer, making structural and traffic connection studies and developing plans. Co-operation of all the railroads entering New York has been secured in the effort to adapt the project as efficiently as possible to the New York terminal traffic requirements.



Brooklyn Bridge



ELEVATION OF PROPOSED HUDSON RIVER SUSPENSION BRIDGE COMPARED WITH THAT OF BROOKLYN BRIDGE

While a War Department permit for a bridge over the Hudson at 23d St. has been issued, a site considerably more northerly has been in view for the last dozen years or more, in recognition of the rapid northward shift of business activities in the Borough of Manhattan. The present project, so far as developed until now, contemplates a site in the vicinity of 57th to 59th Sts. Structurally, it involves a suspension bridge with a main span of 3,240 ft. and side spans of 1,710 ft., making the total length between faces of anchorages 6,660 ft.; the clearance height at midspan is 155 ft. and that at the towers about 140 ft. above mean high water. Braced suspension members forming inverted arches 160 ft. apart carry a double-deck roadway, the upper for highway traffic and the lower for railway traffic, both carried by a single plate girder floor-beam construction. Each suspension arch consists of two eyebar chords in the same vertical plane, braced together by a light web system. In so large a structure protection of the material from corrosion is held to be a primary essential in order to assure permanence; on this account the towers, built of steel, are intended to be incased in a protective masonry shell and the cable chains are provided with continuous sheet copper inclosures. For the same reason the steelwork of the suspended double-deck platform will be protected against the weather by the solid buckle-plate floor carrying the roadway. The only steelwork exposed to the weather will be the bracing between the chords, and the suspenders from chords to deck.

The total width of structure contemplated is 220 ft., as the floor beams cantilever 30 ft. beyond the suspension members. Fascia trusses 32 ft. deep on either side furnish partial stiffening, though the main stiffening is to reside in the bracing members between the superimposed suspension chains. It is also planned to reduce the deflections of the suspension system by supporting the side spans at their midpoints by an anchor column, for the reason that topographical conditions require these spans to be of greater length than the best design of the structure itself would dictate.

Detail designs are being developed on the basis of the above indicated general dimensions and proportions, although these themselves are considered to be subject to modification.

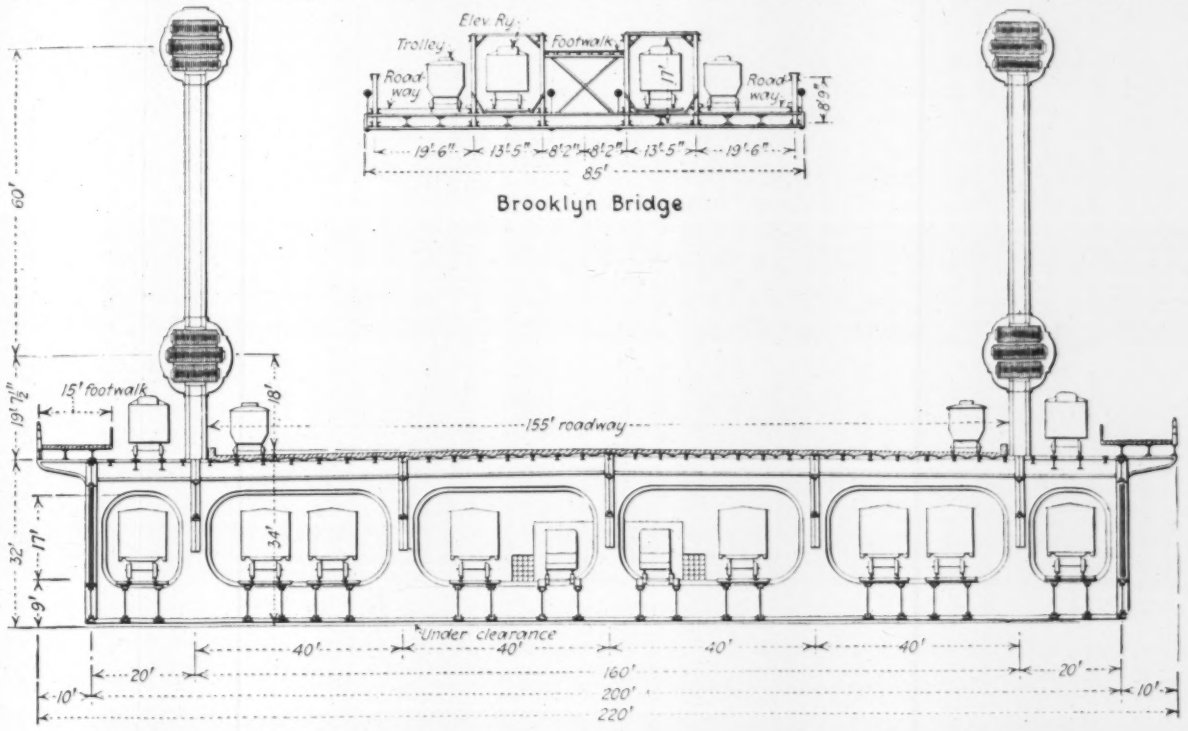
Application of this bridge to the traffic needs to the New York-New Jersey connection will probably use the following general scheme: Highway traffic, to which the entire width of the upper deck of the bridge, with a capacity of 16 lines of vehicles, two wide promenades and two surface-car tracks, is given over, will be led directly eastward in Manhattan to connection with a sufficient number of east and west streets, and north and south avenues to permit effective distribution of the maximum traffic. On the New Jersey side, where Bergen Hill will be cut through by the bridge approach either in tunnel or in open cut, additional roads connecting with the state road system may be required, as the existing streets and roads are inadequate for the increased service. Connections with the low ground east of the hill, with the hill top, and with the meadows level to the west are possibilities.

Railroad connections, for which 10 tracks are provided on the bridge, involve three elements, requiring separate treatment: through traffic, commuting passenger traffic, and freight traffic, the last of which is by far the largest in volume and in difficulty of treatment. On the New Jersey side freight classification and supply necessarily involves a classification yard on the meadows west of Bergen Hill and adequate trackage connecting it to the several railroads, as well as running tracks from the railroad main lines direct to the bridge tracks for through traffic. On the New York side the project comprises a union passenger station, a double freight trackage and warehouse system extending down the west side of the island to the lower limits of the commercial district, and provisions for commutation passenger service either integrated with one of these

two elements or separately making connection with the city transit lines.

Descending from the bridge level on grades of 2½ per cent or less, the railroad tracks (on the lower deck) would swing southward by way of a line west of Ninth Ave. to a large passenger station of through arrangement not far from 42d St. The tracks passing out of this station to the south would again turn westerly and loop back northward to the bridge. Other tracks would pass south and west from the bridge, leading into a freight-track stem located between 10th Ave. and West St. and continuing southward to the collecting, distributing, and warehouse system already mentioned, which would extend from Little West 12th St. to the vicinity of Liberty St. Between the bridge and Little West 12th St. the track system (including the passenger terminal) is adaptable to either elevated or subsurface construction. In the terminal and warehousing section of the line, however, the tracks will be elevated, leaving the street level free for access of trucks to freight elevators.

The full development of this part of the system will most likely be carried out in co-operation with the newly appointed interstate port authority. Its characteristic feature is the provision of distributed team and warehouse terminal facilities along the entire length of the line, as well as direct connection by either rail or truck to the shipping piers along West St., and at the same time to leave existing street facilities substantially undisturbed. The practicability of operating this system as a railroad will be assured by one-way or loop operation. A capacity of 10,000 cars per day can be reached, and the system will have standing room for a sufficient number of cars and motor trucks to allow of developing this capacity.



CROSS-SECTION OF ROADWAY OF PROPOSED BRIDGE ACROSS HUDSON RIVER AT NEW YORK

British Tests on Concrete for Ships

EXPERIMENTS on concrete to be used in ship construction paralleling those carried out by the U. S. Emergency Fleet Corporation were made during the war by the British Admiralty, and later by the Controller General of Merchant Shipping. A paper giving some of the results was read by T. B. Abell before the Institution of Civil Engineers. It may be abstracted as follows:

Compression tests show a wide variation. The concrete was of a rich mixture varying from one part of cement with 2.67 parts of mixed aggregate to one part of cement with 3.66 parts of mixed aggregate. The aggregate consisted of natural gravel or crushed stone passing through ¾-in. square or ½-in. round holes. There was no disadvantage in using a well-rounded smooth beach gravel as aggregate. Better results were obtained with such an aggregate than with an angular aggregate. Good grading of the aggregate, together with extra fine grinding of the cement, were always found advantageous.

Density of concrete is important for ship construction, since the weight of the ship without cargo is an important factor in determining the dimensions of the ship. The extreme variation in weight per cubic foot amounted to 10 lb., involving nearly 7 per cent variation in the weight of the hull structure.

Bending tests were conducted on reinforced concrete beams to determine (1) The value of concrete under tension; (2) The comparative value of round bars and different types of wire rope for reinforcement; (3) The behavior of concrete under alternating stress: (a) At a stress less than that corresponding to rupture under tension; (b) At a stress greater than that corresponding to rupture under tension.

The beams for the alternating tests consisted of hollow cantilevers of rectangular cross-section erected vertically. Their lower ends were fixed in the ground, and the upper ends were subjected to an alternating force having a frequency of

4 to 7 (complete reversals) per minute. The calculated stresses in the concrete during the experiments were 180 lb. and 360 lb. per square inch. The cantilevers were filled with water so that evidence would be forthcoming directly the concrete on the tension side was completely fractured. Cracks were produced after a time with the tensile stress as low as 180 lb. per square inch. The noteworthy feature about the tests was the eventual sealing of cracks through which water had been percolating. Whether the sealing was due to further hydration of the cement after grinding under the alternate opening and closing of the crack was not determined, but the cracks remained tight and were only reopened on increasing the load. The total number of reversals was 200,000 on one beam and 100,000 on a second. Further tests were made to determine whether concrete could be placed on a practical scale in thin slabs so as to act as a container for heavy oil fuel of high flash point, and also for gasoline. There was no difficulty in regard to the heavy oil, and though with extreme care concrete containers might have been made to retain gasoline it was decided that the risk would be far too great to enable gasoline to be carried in bulk in a ship.

The remaining tests relate to experiments carried out to determine the permeability of concrete, the means of protecting reinforced concrete from the corrosive action of salt water and from the disintegrating effect of vegetable lubricating oils on the interiors of the self-propelled vessels. It was found that without any surface treatment 2-in. slabs of concrete, cast with their faces vertical, would frequently resist water pressure of 200 lb. per square inch. It was concluded that it was unnecessary to use any waterproofing compound, and that the richness of the concrete together with the grading of the aggregate were sufficient to guarantee watertightness.

Flow of Water in Tile Drains

A NEW formula for computing the flow in tile drains was presented at the annual meeting of the Iowa Engineering Society by D. L. Yarnell, senior drainage engineer of the U. S. Department of Agriculture. He pointed out that in tile drainage work an important problem is the determination of the proper size of tile to be used, but that many of the formulas in general use were devised when tiles were small as compared with the 12- to 48-in. sizes now used. Continuing, Mr. Yarnell said, in part:

Results of experiments on iron, steel, concrete and wood-stave pipes are not directly applicable to tile drains, as the tiles are usually less regular in size and shape, this condition being noticeable where two tiles are butted together. This unevenness at joints multiplied by the great number of joints, with tiles only 1 to 3 ft. long, disturbs the flow of water to such an extent as to render of doubtful value the formulas for other kinds of pipe. In the new formula, given below, V is the mean velocity in feet per second, R is the mean hydraulic radius and S is the hydraulic gradient,

$$V = 138\, R^{\frac{3}{4}}\, S^{\frac{1}{2}}.$$

This formula is based on a series of experiments made at Arlington, Va., on 4- to 12-in. clay and concrete pipe. The method of its derivation has been given in Bulletin 854 of the U. S. Department of Agriculture. In all these experiments the Kutter coefficient of toughness n and the Chezy coefficient C have been determined. The value of n for tile flowing full but not under pressure lies between 0.011 and 0.012. It was concluded that the value obtained for a pipe with any depth of water less than full does not necessarily apply when the pipe is flowing full. The exponent of the slope, S, was found to be practically 0.5, the loss of head being in proportion to the 2.0 power of the velocity and not the 1.8 power given by many authorities. The exponent of the mean hydraulic radius, R, is $\frac{3}{4}$. Although the Chezy formula gives the same velocity in a pipe flowing full or half full, with the grade constant, "the experimental data seem to disprove this commonly-accepted theory."

Of 75 drainage engineers who replied to a questionnaire of the American Society of Agricultural Engineers, 50 used the Chezy-Kutter formula (with values of n ranging from 0.013 to 0.017), 12 used the Poncelet formula, 13 used Elliott's modification of the Poncelet, and 8 used miscellaneous formulas. The Chezy-Kutter formula was not intended originally for application to flow in pipes.

Experiments on a 30-in. concrete tile drain in Minnesota were made in 1920 by C. E. Ramser, senior drainage engineer, U. S. Bureau of Public Roads, with results as given in the accompanying table. The drain was on a grade of 0.1 per cent and in the first four tests it was under pressure at the upper surface inlet. It will be noted that the value of n for the tile with pressure ranged from 0.0122 to 0.0133, but was 0.1185 for the tile nearly full. The coefficient of roughness increased with the decrease in depth of flow.

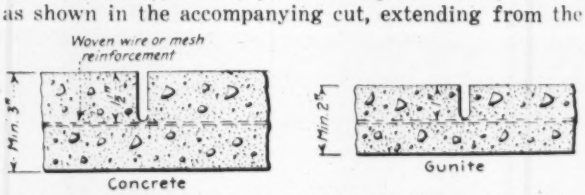
EXPERIMENTS ON FLOW IN 30-IN. CONCRETE DRAIN TILE

Depth of Flow d	$\frac{d}{D}$	Area of Flow a	$\frac{a}{A}$	Hydraulic Radius R	Discharge Q	Velocity V	Slope s	Kutter Coefficient n	Chezy Coefficient C
Ft.		Sq. Ft.		Ft.	Cu. Ft. per sec.	Ft. per Sec.			
.50	1.00	4.91	1.00	0.625	29.96	6.10	0.00551	0.0133	103.9
.48	0.99	4.90	0.99	0.638	23.00	4.69	0.00257	0.0122	115.8
.48	0.99	4.90	0.99	0.638	21.21	4.33	0.00239	0.0126	110.9
.45	0.98	4.87	0.99	0.666	20.16	4.14	0.00210	0.0126	110.7
.26	0.90	4.58	0.93	0.702	17.11	3.73	0.001345	0.01185	121.3
.92	0.77	4.03	0.82	0.753	13.44	3.33	0.001126	0.0126	115.0
.59	0.64	3.28	0.67	0.713	9.74	2.97	0.001017	0.0127	110.3
.31	0.52	2.60	0.53	0.640	6.56	2.52	0.000966	0.0135	101.3
.21	0.48	2.35	0.48	0.610	4.95	2.11	0.000966	0.0154	86.9
.74	0.29	1.22	0.25	0.420	1.63	1.34	0.000976	0.0178	66.1
.67	0.27	1.06	0.22	0.388	1.31	1.24	0.000966	0.0186	60.1

During the past year Mr. Yarnell interviewed a number of drainage engineers in Minnesota and found that they used almost exclusively the Chezy-Kutter formula with a coefficient of roughness of 0.013 or 0.015, but the Arlington tests indicate a value of 0.011 to 0.012. Mr. Ramser's experiments on large sizes of tile show a value of 0.012 for tile flowing full and Mr. Yarnell suggested the desirability of further experiments on large sized tile in order to determine the coefficient of roughness and also to check the accuracy of the new formula.

Special Joints for Concrete Canal Lining

In the U. S. Reclamation Service Flathead project in Montana the new design for concrete lining of the canal calls for alternate bids for reinforced concrete 3 in. thick and for gunite 2 in. thick, each carrying a woven wire or mesh reinforcement at its middle line. Contraction, or expansion, joints are placed every 10 ft. as shown in the accompanying cut, extending from the



CONCRETE LINING JOINT EXTENDS ONLY TO STEEL

base of the lining to the steel only. In explaining the detail J. L. Savage, designing engineer, says: "The joint is intended to locate the contraction cracks by weakening the section of concrete at 10-ft. intervals. Attention is called to the fact that the lining is reinforced very lightly and no attempt has been made to reinforce against temperature stresses. For this reason the lining without joints would crack at frequent intervals with irregular cracks. It has been found that the cracks can be controlled by grooving the green concrete as shown on the drawings, and a very much better appearance results in the finished work."

Quantity, Surveys and Estimate Payments in Construction

Recommendations of Incompleted Joint Report—Reduction in Estimating Overhead to Be Test of Survey's Usefulness

A JOINT committee of representatives of the American Institute of Architects, Engineering Council, and the Associated General Contractors of America has been studying the subject of quantity surveys and payments for estimating since the fall of 1919. Though the report is not yet complete the committee on methods of the Associated General Contractors submitted, at the recent New Orleans convention of the association, certain extracts from the latest draft of the joint report. This draft has not been approved by the committee or any of the associations represented on the committee and is not final.

That accurate predetermined quantities insure economy both to the owner and to the contractor; that known requirements promote healthy competition; and that competition should be substituted for speculation are the fundamentals underlying the committee's recommendation that "architects, engineers and contractors should jointly use their efforts to have established facilities for making quantity surveys in their respective communities."

Survey's Advantages

The partial report of the committee points out that the advantage of a quantity survey to the prospective owner is a saving in the overhead charge which he must pay to the contractor, by reason of the contractor's including in his successful bid the overhead charge for estimating upon bids in which he was unsuccessful. By the quantity survey, then, the owner pays only for the cost of estimating the particular project in which he is interested.

The advantage to the contractor is that all contractors are placed upon the same basis with some means provided whereby the work as proposed will not be left to individual interpretation of the plans and specifications. It also allows the contractor to submit a lower bid.

The committee recommends to architects and engineers that unless elininated for some particular reason all plans and specifications submitted to contractors for proposals should be accompanied by a quantity survey and the net result should be a reduction in the contractor's proposal. It also recommends that quantity surveys for purely building purposes should be insisted upon, providing the net result will be to reduce the prices on any specific project. From one-fourth of one per cent to one per cent of the cost of commercial or public works building and not more than twice that for residential construction is the recommended fee.

The committee believes that the owner should pay for having an itemized list of all quantities entering into the proposed work made, whether he proceeds with the building or not. It is obvious that such payments would be much less than the owner would otherwise pay, as each bidder is furnished with this list of quantities, and thereby released from the work entailed in taking off the quantities from the drawings and specifications.

With these foregoing conclusions as a basis, the committee makes the following recommendations:

1. *Quantity Surveying*—Architects, engineers and contractors should jointly use their efforts to have established facilities for making quantity surveys in their communities.

2. *Cost of Survey*—From one-fourth of one per cent to one per cent of the cost of the project for commercial and public work and not more than twice as much for residence work, should be the cost of the survey.

3. *Basis of Contracts*—Owners have the option of: (a) Making the quantity survey a part of the contracts; (b) giving the successful bidder, at his own expense, an opportunity to verify the accuracy and completeness of the quantity survey before the contract is signed. If he proves an error to exist in the survey the bidder shall be permitted to adjust his bid accordingly.

4. *Unit Quantities and Standards*—The schedule of unit quantities should conform to local customs or methods of measurement and should be so stated on the survey. The eventual adoption of national standards is recommended.

5. *Guarantee*—The guarantee of quantities by the quantity surveyor is not recommended for it might influence the surveyor to protect himself by increasing the quantities. The extra cost of the guarantee would not be warranted.

6. *The Cost of Preparing Survey*—The cost of preparing the quantity survey should be borne by the owner, whether the project is constructed or not.

7. *Existing Systems*—Existing systems which do not eliminate duplication of estimating effort or which do not produce the most economic results to the owner are not endorsed, but it is realized that existing systems will continue in operation until quantity survey bureaus are established so as to be available in each community.

8. *Payments*—Payments should be made by the owner to each bidding contractor based on an individual certificate issued by the architect or engineer. The amount of the payment should be:

(a) Where a quantity survey is furnished: no payment.

(b) Where a quantity survey is not furnished.

Under the system of duplication of the determination of quantities now in vogue each contractor is put to large expense for such estimating of quantities. Therefore, where plans and specifications are not accompanied by a quantity survey furnished by the owner, the owner should agree to pay to each contractor submitting a bid on his project, for the preparation of an estimate or survey of quantities one-half of one per cent of the cost of the project on all commercial or public work and one per cent on all residence work regardless of whether the contract is let or not.

9. *Cost of Project*—The cost of the project is defined as the accepted bid or, in cases where no bid is accepted, the bid of the lowest responsible bidder as determined by the architect or engineer.

10. *Alternate Bids*—Alternate bids when requested by the designer should be paid for by taking the sum of the cost of one bid plus the cost of such alternate bids involving refiguring of quantities.

11. *Altered Plans*—Altered plans which involve a change in quantities justify an addition to the original payment for estimating on the same basis as the first estimating fee.

12. *Sub-contracts*—Sub-contracts where the quantity survey does not cover the sub-contractor's work general contractors should

(a) provide such quantity survey or

(b) arrange for payment for estimating to sub-contractors, making due allowance for the contingency that the same sub-bid may be submitted to several general contractors.

World Production of Coal in 1920

According to a recent bulletin issued by the United States Geological Survey, the world production of coal during 1920 was 97 per cent of that produced in 1913. Total coal produced during 1920 was about 1,300,000,000 metric tons, of which the United States produced approximately 45 per cent. Although this represented a large increase over 1919, it was still 42,000,000 tons short of the output in 1913.

Eight-Story Steel-Frame Building Moved on Rollers

Pittsburgh Building in Way of Street Widening Moved Forty Feet — Load Carried on Temporary Column Brackets

By E. Dauenhauer
Chief Engineer, John Eichleay, Jr., Co., Pittsburgh

THE widening of Second Ave. by the city of Pittsburgh made it necessary to move the eight-story Woodwell Building from its location on the corner of Second Ave. and Wood St. to a new site 40 ft. back from Second Ave. The structure is a narrow steel-frame building, 20 x 80 ft., with brick walls and fireproof floor construction; its total weight is about 5,000 tons, which is carried by twelve steel columns, six on either side. The John Eichleay, Jr., Co. undertook to move the building and to keep it in service during the entire operation. This undertaking was successfully carried out, the building being not only moved to its new location, as shown in Fig. 1, but elevator, telephone, heating, lighting and sanitary service being maintained while the structure was in motion.

The columns on the south or Second Ave. side of the building had their footings at basement floor elevation,

FIG. 1. BUILDING MOVED FROM CORNER (LEFT) TO ITS NEW POSITION

but those on the north side extended 15 ft. lower, and were proportioned for a future twenty-story building, being party-wall columns. These party-wall columns were burned off at the basement floor line when the column load had been transferred to the rolling blocking by attached brackets preliminary to moving.

New concrete column piers to receive the building were prepared at the new site. A grillage on which to raise and move the building was prepared of 3-in. plank laid close over the whole site, flush with the pier tops, after the soil had been leveled and tamped; on this were laid transverse 12 x 12 timbers 18 in. on centers, and longitudinal 12 x 12 timbers to receive 21 rows of 20-ton jacks, 1 ft. on centers. The jacks (Fig. 2) carried a layer of 6 x 8 blocks supporting a rolling track of 85-lb. rails. Three-inch rollers traveled on these rails. The load was brought on the rollers by ½-in. steel roller plates, a 3-in. wooden cushion, another ½-in. plate, and lines of three 24-in. 100-lb. steel I-beams, one

FIG. 2. ROLLING TRACK AND BRACKET SUPPORT

line along either side of each column to be moved. Specially constructed steel brackets were riveted to the columns for transferring this load to the I-beams.

There were two lines of jacks either side of each column. For raising, one man was assigned to about 20 jacks, and at a signal each man gave a quarter turn to his set of jacks, passing down the line, and a second quarter turn on the return, then waiting for the next signal. By this procedure the building was raised evenly. A total raise of 12 in. was required to suit the new site, in addition to the raise necessary for transferring the load.

Moving the building was accomplished by placing twelve drums with jacks against the building, and went on at the rate of 3 ft. per hour. As part of the movement was over a sand and gravel bed, careful levels were taken while the structure was being moved, but no settlement took place at any point. The concrete sidewalks on the Wood St. and Second Ave. sides were carried with the building. After the new location was reached, the old cast-iron bases on the south side were replaced under the columns, while on the north side, where the columns had been burned off, new bases were spliced on and set.

The work required over 100,000 ft. of timbers and lumber, 300 tons of steel rails and I-beams, 1,000 jacks, and 900 steel rollers.

The Activated-Sludge Process of Sewage Disposal

Abstract of paper by George G. Nasmith, Toronto, before the Engineering Institute of Canada, Feb. 3, and of discussion on the paper.

THERE are now three methods of sewage treatment that are capable when carefully operated, of yielding a clear, stable effluent and a nonputrescible sludge: (1) Sedimentation tanks, sludge digestion and sprinkling filters; (2) Imhoff or Travis tanks and trickling filters; (3) activated-sludge digestion (or drying the activated sldge). The first two combinations are well known and, though the inoffensive digestion of sludge in separate single-chambered tanks presents some difficulties, it can be, and is being done on a very large scale, as at Birmingham and Baltimore.

The activated-sludge process will, when the simple but essential conditions of operation are carefully observed, yield a clear, sanitary, non-putrescible effluent. The excess of activated sludge produced is, however, still putrescible, can at present not be cheaply or easily dewatered, and is difficult to dispose of. Should the dewatering problem be economically solved the activated sludge process of sewage disposal would immediately become more desirable and feasible than it is at present, chiefly for the reason that activated sludge has a high fertilizing value and is, therefore, valuable from the standpoint of conservation. The activated-sludge process, as carried out at present, though embodying many good features, has some undesirable ones, and is by no means the last word in sewage disposal.

Advantages and Disadvantages of the Process

The advantages of the activated sludge process of sewage disposal are: (1) The plant is comparatively simple in construction, consisting, as it does, of a series of tanks and means for injecting finely divided air at the bottom of the same. (2) It will produce in the one operation an effluent that can be obtained in other systems, only by a combination of operations. (3) It is, during operation, quite inoffensive. (4) It can be carried on with the minimum amount of pumping.

The inherent disadvantages of the activated-sludge process over other combinations are not negligible. Where improperly operated, the effluent is neither stable nor sanitary. Disinfectants and certain trade wastes are liable to destroy the activated sludge; under these circumstances it will take weeks to build up again the necessary volume of activated sludge. The filtros plates used for finely dividing the injected air are subject to plugging with smoke and dust, in which case the areas of sludge not agitated are apt to undergo anaerobic decomposition, while there are inherent difficulties with air blowers and other mechanical features of the aeration system. Though attempts have been made to derive an income from the dried activated sludge as a fertilizer, the hopes entertained have not as yet been realized in practice and it is doubtful if the day has yet arrived when the chemist or sanitary engineer is honestly justified in advising that an activated-sludge system be constructed with the guarantee that the increased cost of the plant or the high cost of operation will be compensated for by the sale of sludge or other material derived from the process.

On the other hand, some cheap method of satisfactorily dewatering the sludge may entirely change our viewpoint in regard to this matter. The activated-sludge system is unsuitable for small communities or large institutions where an automatic system is highly desirable.

The dewatering of sludge can only be brought about in two ways, viz.: the expression of the bulk of the water present by pressure methods such as the sludge press—a very cumbersome and objectionable process—or through the more recent method of centrifugal action. Both of these methods will produce a sludge cake containing from 75 per cent to 80 per cent moisture from which the remaining moisture must be removed by heat.

A centrifuge of the Basco Ter Meer type has been experimented with for a month at Milwaukee and promises to be more suitable for dewatering Milwaukee activated sludge than sludge presses. The machine is almost automatic in operation, occupies 15 minutes for each cycle, and will centrifuge from 2,000 to 4,000 U. S. gallons of sludge per hour. It takes a sludge containing 98½ per cent moisture and reduces the moisture to from 79 per cent to 85 per cent. About 20 per cent of the solids of the sludge pass over the filtrate and it is expected that, with experience and improvements, it will prove more efficient and satisfactory than any type of sludge press hitherto tried out.

F. A. Dallyn, Sanitary Engineer, Ontario Provincial Board of Health — Dr. Nasmith said that he did not think the activated-sludge process applicable to smaller plants. We have found it most excellent for institutional plants in Ontario. At one of these we find that we can put the air compressor in a boiler room or in one of the machinery buildings and treat the sewage of the institution practically without supervision. An activated-sludge plant in use at the Guelph Agricultural College since 1917 has given uniformly good results. It has been neglected occasionally, but it has been easy to rectify any trouble caused by neglect so that within a day or two the plant could be in good working condition.

We have recently uilt two other plants: one at an institution at Orillia and another at the prison farm at Burwash. They are both giving excellent satisfaction.

In the last two years I have strongly advocated the adoption of the activated-sludge process in remodeling some of the sewage disposal plants in the province. The cost of this remodeling has been a minor matter as compared with the cost of introducing some of the older methods, and the results we expect to obtain are much more satisfactory than under the operating conditions we have had before.

The city of Kitchener [formerly Berlin] when activated-sludge was in its infancy did not feel like experimenting with the activated-sludge process. It put in a plant of another type with a capacity of 800,000 Imp. gal. a day that cost roundly $60,000. Recently Woodstock built an activated-sludge plant with a present capacity of 2,500,000 Imp. gal., with provision for enlargement to 4,000,000 gal., and the construction price was only $55,000 under existing high cost. Such saving in interest charges alone warrants, to my mind, a municipality in making such an experiment because I think our knowledge of sewage disposal is advancing so rapidly that expenditures for the older systems are not warranted because they would probably be scrapped inside of fifteen years.

The Ontario Provincial Board of Health has been experimenting with the activated-sludge process for some years. I was sent to England to see everything that was to be seen there in 1916 and again in 1917 and still again in 1918.

Air Fed from One Side of Tank

In our experiments, instead of using the saw-tooth bottom, like that at Milwaukee, the air is fed from one side of a long tank at a probable increase of 25 per cent in efficiency. This arrangement is particularly advantageous in connection with the remodeling of old septic tanks, of which there are many in this province. In such remodeling a row of porous plates can be put at one side and the old tanks divided by partitions into widths of 6 to 9 feet.

I am confident that the operation of the activated-sludge process can be made largely automatic and if this can be done then with the decreasing cost of hydro-electric power in Ontario, which may be expected in the next ten years, the activated-sludge process will be brought quite within the realm of municipal economy.

As to dewatering the sludge, our experiments have shown that by putting the sludge in a separate tank, activating it, and changing the water three times we can reduce its moisture content to about 65 per cent. In so doing, however, we lose about half the nitrous contents of the sludge, producing about 2½ p.p.m. of nitrogen instead of 4½. That is a considerable loss and the question is whether by further studies we can maintain more of the nitrogen content.

There does not seem to be any question but what the sludge from the activated process will have a fertilizing value with an increasing market. The abattoirs are very

largely withdrawing from the fertilizer market because they are finding other uses for their products. They can convert many of their former waste products to stock foods.

Mr. Redfern — Plans for an activated-sludge plant with a capacity of 200,000 Imp. gal. per day, with a 6-hr. period of aeration, and a maximum capacity of 500,000 Imp. gal. per day, have been submitted by the town of Newmarket to the Provincial Board of Health and have been approved by the board. The lowest bid for the construction of the plant, complete, was $31,000. I think this price was lower than could have been obtained for any other type of plant even with the high cost of materials and labor that existed at the time, but the building of the plant was put over for a year or two. I have no doubt but that it will be built soon.

William Gore, Consulting Engineer, Toronto — Experiments with the activated-sludge process have been carried out by Dr. Nasmith and myself. The raw sewage is first mixed with well digested sludge and then passed to an ordinary activated-sludge tank. The sludge formed in the activated-sludge tank is returned to a digesting tank. The effluent has a slight straw color. We have run for some periods with as low as ⅛ cu.ft. of air per gallon based on a 10-ft. depth of tank, our tank being only 7½ ft. deep.

Inclined Wall Braced by Struts to Hold Sliding Loess

Slides Threatening Illinois Hospital to Be Checked by Reinforced-Concrete Retaining Wall of Unusual Type

A RETAINING WALL decidedly different from standard walls is under construction at Menard, Ill., to arrest slides and slumps which in the past have occurred on the north and northwest side of the State Hospital for Criminal Insane. The general topography of the site is shown in Fig. 1. The slides, indicated on the map by wavy lines, have been of frequent occurrence during the last few years and it was feared that they might endanger the safety of the building. In the lower part of the drawing, a cross-section looking northeasterly, the various underlying strata are shown. The thickness of these strata, as well as their slope, varies considerably, but the section illustrated may be considered as fairly representative and has been made the basis for the design of the wall.

The loess, which is the surface material, is a brown soil composed of a very fine wind-blown silt containing sufficient clayey material to bind it together so that it often stands with a vertical face. As it is exceedingly porous, water passes through it readily. If the base of the deposit becomes saturated it loses its "body" and unless confined has a tendency to run under the weight of the overlying loess. The slumps or slides mentioned are therefore most likely to occur after a heavy rainfall, the main cause being the saturation of the base of the loess, and a contributing cause the slipperiness of the supporting impervious shale when wet.

The shale varies greatly in character, the poorest kind being little more than compacted mud, becoming soft as clay when wet. Other deposits are very calcareous and there are even certain lenses of limestone. Such shale

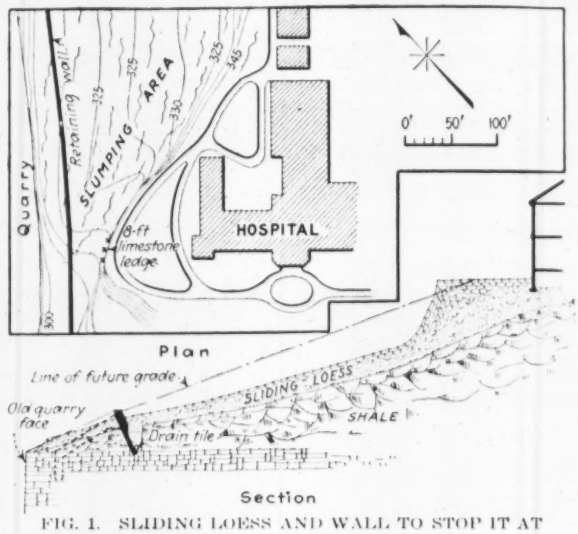


FIG. 1. SLIDING LOESS AND WALL TO STOP IT AT ILLINOIS HOSPITAL

is but very little affected by water. In general the shale is hard and firm and affords an excellent foundation for the building, except when long exposed to the weather or poorly drained.

The limestone occurs in strata several feet thick and makes a perfect foundation for the wall. It is well exposed at the quarry ledge and on the lower slope of the bluff.

On account of the unusual conditions, the amount of the lateral pressure against the wall is even more uncertain than in the case of ordinary retaining walls supporting earth pressure. A limiting value of the thrust could evidently be obtained by considering the loess as a fluid of weight 100 lb. per cu.ft., acting on the total vertical height of the slope. However, as it is evident that such a pressure cannot exist, due to the inability

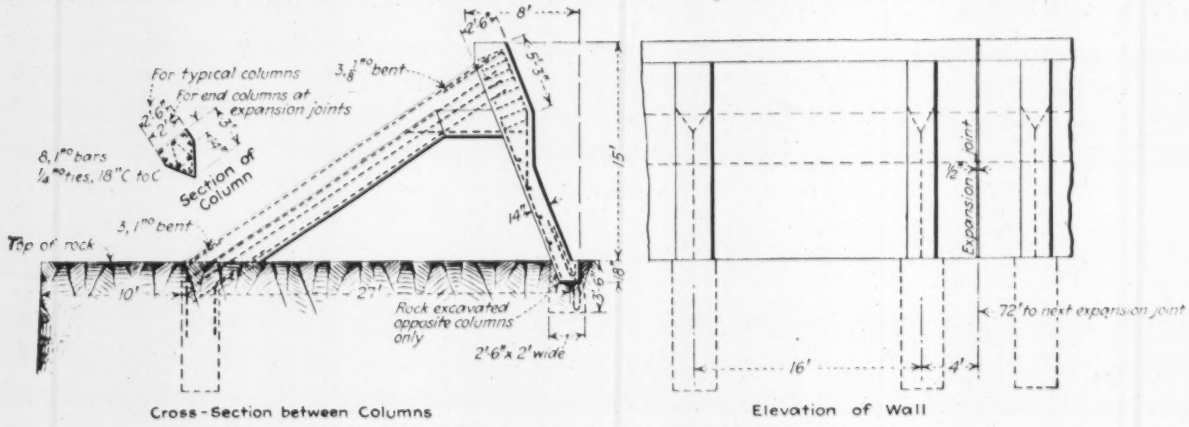


FIG. 2. RETAINING WALL AT ILLINOIS STATE HOSPITAL

of the overlying material at the lower end of the slope to resist any great amount of upward pressure, this principle of pressure calculation was not used. Nor was it thought necessary to consider any dynamic force against the wall due to the motion of the loess; for the displacement of this material after a slide was found to be a few inches only and its velocity very small.

It was finally decided to consider as actual lateral pressure the component of the total weight of the material above the shale parallel to its under side, reduced by the frictional resistance of the loess against the shale. The coefficient of friction was taken as 0.15. Considering the section shown in Fig. 1 as representative for the entire length of the wall, there is obtained the total normal pressure for one typical 16-ft. bay as follows:

The total amount of loess supported is 32,000 cu.ft., which at 100 lb. per cu.ft. weighs 3,200,000 lb. The component of this force parallel to the top of the shale is 800,000 lb. which reduced by a frictional resistance of 3,100,000 x 0.15 = 465,000 lb. gives a total normal thrust of 335,000 lb.

The upper part of the wall has been designed as a beam of 13½-ft. clear span to resist this pressure, and the inclined columns have been designed for approximately the same load. The amount of steel, 10 sq.in., in the center of the beam span is slightly in excess of that at the column supports due to the T-action of the lower part of the wall. Prison labor being available both for crushing stone and for general concrete work, the cost of the concrete is exceptionally low, and therefore the percentage of steel has been kept somewhat lower than is common in ordinary practice.

The wall was designed and the work is being executed under the direction of the Department of Public Works and Buildings of Illinois, for which Col. C. R. Miller is director, Edgar Martin supervising architect and A. S. Ritterwold engineer in charge.

British Road Classification Completed

The classification of roads in Great Britain is now complete, the percentages of first and second-class roads being as follows:

	Per Cent
England and Wales, first class roads	11.6
England and Wales, second class roads	7.0
Scotland, first class roads	17.9
Scotland, second class roads	13.1

The money derived from the tax on all mechanically propelled vehicles will be paid into a central fund. Fifty per cent of the cost of maintenance of the first-class roads and 25 per cent in the case of second-class roads will be contributed from this fund, the remainder to be found by the local authorities.

The Ministry of Transport has issued a return of the amounts collected by local authorities in road taxes from Jan. 1 to March 7; this totals £7,092,422. The following is the approximate analysis of the sources of this total:

Class	Number of Licenses	Receipts
Cars taxed on hp.	202,000	£2,810,800
Motor cycles	186,000	488,600
Bath chairs, etc.	200	50
Commercial motors	117,500	2,330,200
Road locomotives, etc.	1,800	29,150
Motor ploughs, etc.	6,000	1,500
Motor tractors, etc.	900	13,850
Taxicabs, etc.	41,700	1,190,500
Tramcars	15[0]00	11,250
General identification marks	5,900	48,250
Horse-drawn (private and hackney)	180,000	135,000
Miscellaneous receipts	.....	33,250
	757,000	7,092,400

Notes From Foreign Fields

ENGINEERING IN VENEZUELA AND COLOMBIA

By Jacob L. Crane
Formerly of Gannett, Seelye & Fleming, Harrisburg, Pa.

THE great mineral and agricultural resources of Venezuela and Colombia present the incentive for, and their climatic and physical characteristics from the intensely hot sea-coast area to the cold mountain ranges of the Andes constitute the obstacles to, extremely interesting engineering achievement. Unusual difficulties have to be overcome, such as instability of governments, total lack of co-operation between adjoining countries, difficulties of climate such as disease for agents and workmen, and physical handicaps equaling those in some of the famous projects of this country.

Roads.—The original roads of these countries were first foot paths and then mule trails following the streams and meandering through jungles and over the mountains. Now, however, the highway building era is well under way and such roads as that from LaGuayra to Caracas, or from Estacion Tachira to Cucuta are good example of the progress being made. In the cities the old pavements are of cobble, while the newer ones are of macadam or in some instances ashphalt. The country roads of the better type are built of Telford macadam and seem to be well made. Of course labor is cheap (40 to 80 cents per day) and plentiful, and in the writer's opinion fully as intelligent for this work as American labor.

On the mountain roads the curves are more frequent and sharper than one ordinarily finds in this country, but the grades are low and uniform. The maintenance on the newer roads is good; one maintenance man is assigned to each kilometer of road and it is his duty to keep that section in good shape. Compared to our busy roads, the traffic is light consisting largely of Fords, mule carts, pack trains and pedestrians, but it is now increasing rapidly. The advent of the automobile and the commercial need of roads are now such that the roadbuilding program may be expected to continue until thousands of miles of good highways connect all important points. Roads are most essential in these mountain regions because railroad construction is so expensive that automobile transportation over good roads is more economical.

From Stone Arch to Steel Bridges

In both countries the construction of picturesque stone arch bridges seems to have passed and in some sections, following an intermediate period of timber construction, the era of the American steel bridge is coming in. There is little doubt that the steel bridge will displace the older type almost entirely until the countries have developed to the point where they again desire and can afford picturesqueness or beauty in such structures. Then, perhaps, the modern stone and concrete bridge will come in. The people have a strong natural instinct for picturesqueness in their structures, and it is to be hoped that after we have given them the value of our steel-bridge developments, they can help return to us that which so many of our engineering structures

lack—the stamp of beauty and of fitness in their surroundings.

Railroads and Sanitation.—The topography and development of these countries have made for short railroad lines. Most of them are narrow gage and vary in length from about 8 to 150 miles. The typical railroad connects a river or seaport with the highway outlet from mountain district or with one of the larger interior towns. They are, of course, very important in agricultural and industrial development, but they seem miniature compared to our railroad systems. The older railroads are owned largely by European capital, but the newer projects are natively owned and operated. For the most part the locomotives burn wood. Some of the roads do not pay an adequate return on the investment and in certain instances much needed lines will have to await further development of the country or substantial government subsidies.

In the larger cities there are usually street railways of some sort. Some of these use storage battery power, and in one instance the steam railway leases the trolley tracks from the city and the wood-burning locomotives haul the tiny street cars over them at infrequent intervals.

Water Supply—Public Health

Water supplies in general are bad. They vary from rain water carried on mule back from house to house to stream water delivered through pipe systems and nearly always unsafe for drinking. A system that is not uncommon is to bring water from a stream of questionable potability through a town in an open ditch in the middle of the cobble pavement. Each householder takes his water from the ditch by hand and empties back into it his waste water and sometimes sewage, so that the people on the lower end of the line get the waste from the upper end. There seems to be no objection to filthy water for all household purposes.

The requirement for water is much less than with us. Baths are rare, little water is used for any kind of washing or for street or municipal purposes, there is practically no demand for industrial water, and little need for fire protection, as most structures are built of clay or stone. Under these conditions the frequent evidence of interest in new water-supply projects may be considered remarkable, but it is real and is bound to produce results.

Sewers are known in only a few of the larger towns, and there they are used only by a small upper class. The outdoor closet is uncommon and the few one sees are extremely objectionable. Usually both in the towns or in the country either an open or fenced enclosure in the rear of the premises or nearby is used, and the material deposited on the ground, sun and wind-dried, or removed by the fowls and the pigs. Crude as this may seem, it is not so objectionable as the water carriage or dry closets in the hotels. However, the effect of this method of sewage disposal in producing enteric and hookworm diseases must be severe. Garbage is generally fed to chickens or pige, even in the larger towns, so there is rarely any garbage problem.

There is no system of vital statistics in either country, so the author was informed, and it is therefore impossible to determine disease and death rates with any degree of accuracy. However, it is apparent that the people of these countries are sick a great deal, often from unidentified diseases as well as from those well known, and the death rate must be high. Yellow fever is practically gone, but malaria is widespread and nearly every one has it sooner or later. Mosquito eradication has not been undertaken to any extent.

Town Planning.—What seems to have been unconscious town planning has produced many communities with a certain stamp of picturesqueness and with utilities fairly convenient and fitting. The discounting features often met are too-narrow streets, dirt, crowded districts, and bad sanitation. One can readily believe that the people of these republics will demand beauty and convenience throughout their civic developments sooner than good sanitation. As a matter of fact, in spite of the dirt, odors and poverty in these tropical cities they often possess a general effect of better town planning than one usually finds in cities of the United States and Canada.

One discouraging situation was found in the case of a town of 20,000 people which was entirely destroyed by earthquake about fifty years ago (most of the towns are one or two centuries old) and rebuilt in imitation of American cities. The result is a rectangular street plan with wastefully wide, sun-scorched roadways, unadorned and barren, and leading pointlessly straight across the town; badly situated public buildings, and loss of the usual picturesque effect. The only gain seemed to be in a somewhat better ventilated city.

Industry and Agriculture.—There are a few small factories in the larger seaports, but the principal industrial activity is mining, and the great future development is oil. Colombia produces much of the world's platinum and most of the emeralds, and both countries are still rich gold producers. Both, it has recently been determined, have large, rich oil deposits. Already a few companies are shipping oil, there are a few refineres in operation, and many companies are exploring and starting operations. However, many of the oil deposits are so remote that they cannot be profitably exploited as yet. It seems certain that this territory is destined to be one of the great oil fields.

Irrigation Opportunities

Irrigation, often on a large scale, will be required for sugar plantations which promise to be one of the chief features of agricultural development to come. In this climate sugar requires from 5 to 10 gal. per minute per acre irrigated, the year round, or a total of from 80 to 150 in. per year. No hydrographic data are available and only meager empirical information about irrigation.

While there are many difficulties and annoyances to overcome particularly a severe tropical climate and its resulting insects and fevers, in some ways it is easy to work in Venezuela and Colombia. The individual American is treated with more consideration than almost any one else, and the people are usually ready to do business with him. Every phase of development requires engineers first of all, and American machinery and equipment. It seems that any qualified and intelligent engineer can make his fortune there if he is willing and able to put up with the discomforts and diseases for a number of years. This is, however, a rather severe requirement. It is to be remembered that work must be done and goods furnished faithfully and competently for the genuine good of the people there, if American engineering enterprise is to fulfill its destiny in these two rich Caribbean republics.

LETTERS TO THE EDITOR

If you have ideas that would interest engineers and contractors we shall be glad to give them space here. We urge, however, that you be brief so that a wide range of subjects may be covered in the available space.—The Editor.

Another City That Recognizes Engineers

Sir—The letter of A. L. Dabney regarding engineers in the city government of Memphis, Tenn., and your editorial comment (*Engineering News-Record*, April 28, 1921, pp. 734 and 706) have been read with interest. I wish to call your attention to the members of the municipal government of the city of Miami Beach, Fla., who have engineering training or experience. On the City Council of seven members there are two civil engineers in active practice, a former practicing mechanical engineer and a former manager of large mines in the Cripple Creek district of Colorado. The city engineer is a graduate civil engineer; the water superintendent is a graduate engineer; and the city clerk, until occupying his present position, was an engineering draftsman and office manager.

The population of Miami Beach is about 525. It is one of the wealthiest cities per capita in the United States. Its assessed valuation for the past four years has been: 1917, $647,500; 1918, $832,745; 1919, $2,579,600; 1920, $3,933,700.

W. E. BROWN,
Miami Beach, Fla., May 5. President City Council.

Deceptive Highway Propaganda

SIR—I know that *Engineering News-Record* will not willfully or intentionally misrepresent or make false statements. I am writing, therefore, to ask that you publish this in answer to the editorial appearing in your issue of April 28, p. 706, entitled "Deceptive Highway Propaganda." You state; "Alabama is another case in point. In the propaganda for a recent bond issue of $25,000,000 a circular issued by the Alabama Highway Improvement Association carried these statements: 'This is a 50-50 proposition. Uncle Sam puts up $1 and requires the State to match it. If Alabama fails or refuses to put up, the money goes to other states.'"

Then you state: "The plain inference here is that $25,000,000 of federal funds would be forthcoming in the event of an affirmative state vote."

If the circular contained that statement and that alone one would be justified in drawing your inference. In the same circular you refer to you will find in large type the following: "The $25,000,000 bonds will enable Alabama to cover Uncle Sam's offer dollar for dollar, *as it is offered*."

"The Federal Government already has appropriated nearly $6,000,000 to aid Alabama in the construction of good roads."

In the same circular there is a table showing the probable expenditure of the sum voted and anticipated, covering a period of twelve years. It certainly would have been poor judgment upon the advocates of good roads in Alabama to have submitted an amendment to the state constitution permitting the sale of bonds amounting to only the present federal apportionment, and not anticipate additional federal aid.

Amending state constitutions is no easy matter and we certainly do not relish the work of campaigning for an amendment every time the government apportions a sum of money to Alabama. No one was deceived in Alabama and from best information obtainable no one with the exception of yourself and a writer for the American Automobile Association have been able to make a mountain out of this mole hill.

W. S. KELLER,
State Highway Engineer of Alabama.
Montgomery, May 5.

[We are glad to learn from Mr. Keller that the issue in Alabama was clearly understood by the electorate. It is possible, however, that the circular referred to has, in some cases at least, not received the careful study which he has given it. In that event it seems that the wording of the sentences quoted in this journal's editorial might have caused a misunderstanding.—EDITOR.]

Protection of River Banks with Spur Dikes

Sir—It seems to me there is a difference of opinion regarding the length of spur dikes, the distance between them and their location with respect to the direction of the stream. It would be of general interest to learn the opinion of experts in this type of river protection.

The writer is familiar with the two following methods, very frequently employed to find the length of spur dikes.

Method I, Fig. 1.—If *AB* is the spur dike, the length of which has been predetermined, the water is supposed to strike at *AB*, leaving by *A* in the direction of *AC*, making a right angle with *BA*. It is obvious that the greatest stress will react at *C* and, therefore, the second spur dike should be located a little up stream from the point *C*. The same rule is followed for the other spur dikes.

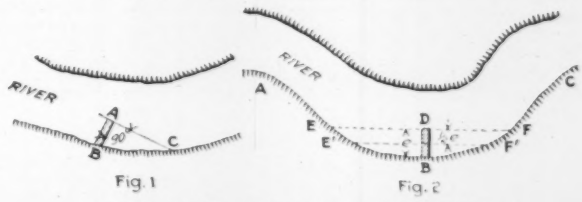


Fig. 1 Fig. 2

SPUR DIKES FOR BANK PROTECTION

Method II, Fig. 2.—The distance between the spur dikes should depend upon the greatest curvature of the river bed, the assumed length of the spur and the *degree of safety desired*. As before, the length of the dike spur is assumed and then the greatest curve of the river is found. Let us assume that *ABC* is the said curve. At *B*, the point of greatest curvature, we place the spur of known length, as if it were the height of a segment. The cord *EF*, corresponding to this "height," will give us the distance between the spur dikes, when the protection does not require a great factor of safety. For protection with double the safety of the first one, we will take the cord *E'F'* to give the distance between the spurs. For a safety three times as big as the first one, one-third of the height should be taken, and so forth.

In reference to the location of spur dikes, their maximum efficiency as protection works, and their stability, I am of the opinion that, in general, they should be built against the stream, either forming an angle of 12 to 17 deg. with the river bank, or normal to this.

ENRIQUE RAMIREZ.
Tinogasta, Catamarca, Argentine, March 15.

Selling Cement Through Dealers

Sir—I was interested in seeing in your issue of April 28, p. 736, my letter to you of March 31 in regard to selling cement through dealers and the reply to a similar letter from the Atlas Portland Cement Co.

The answer of the Atlas Portland Cement Co. is interesting. Its statement about purchasing suits from Hart Schaffner & Marx does not carry a great deal of weight it seems to me. I am very sure that if the Atlas company wished to purchase one thousand suits of clothes, all of exactly the same pattern and made from the same cloth, Hart Schaffner & Marx would bid on the work as would many other suit manufacturers, and the Atlas company would obtain close figures because of competition.

The cement business is not handled in this way. All of the companies pursue the same policy of selling through the dealer as is pursued by the Atlas Portland Cement Co. It evidently is a sound policy for the cement companies but entirely eliminates competition in this very important building material. I know of no other building material that cannot be purchased in the open market on a competitive basis.

The Atlas Portland Cement Co. states very emphatically that it is not tied up by agreement of any kind. Neverthe-

less, if one wishes to purchase cement in quantity, he will receive exactly the same price on every brand of cement that is sold in any particular locality. There is certainly great unanimity of opinion between cement companies and the cement dealers even if there are no agreements.

One is naturally interested to know why of all the building materials cement is one which has to be bought through the dealer and cannot be bought even in the very largest amounts direct from the manufacturer.

The Atlas company states that the cement dealers also sell to the contractors sand, gravel and other building material. That may be so in some instances but it has never been true in any of our work, nor have we ever known it to be true. Sand, gravel and other building materials are purchased on competitive basis and not as cement is.

SAMUEL M. GREEN CO.

Springfield, Mass., May 11.

Expressways for New York Traffic

Sir—In connection with our recent correspondence regarding the matter of my paper on streets and parks (see *Engineering News-Record*, March 31, p. 547 and April 7, p. 577), I quote you from a letter received by me under date of April 25 from W. H. Breithaupt, of Kitchener, Ontario, Canada:

"Enclosed please find the copy you sent me of your paper on Streets, Parks, and Expressways. The latter seem to me the logical outlet for through automobile traffic to which and to bicycle traffic it should be devoted. I would make the approaches in spiral, or rather helix, form thus taking up minimum space, and make one at least every five blocks, that is four to the mile. The main way should be kept well above the tops of ordinary buildings, say 60 ft. or more above the surface. The traffic should be separated, of course, into fast and slow and uptown and down, with separate path for bicycles; motor cycles however would travel with the automobiles.

"There would be various new things in such a way. For one thing the pavement, adapted to the one purpose, could be steel plates or other absolutely durable material. For the helix approaches land off the streets would have to be taken and the surplus land would be easily and very profitably made use of as neighborhood garages.

"The more I think of the general idea the more there seems to be in it and I see no good reason why, with structural material now coming down, at least one such way should not be undertaken at once. There is a way something like the one contemplated at Los Angeles from the main city to the port. In Chicago about thirty years ago there was an idea, about which I was consulted, for an elevated roadway above buildings."

CHARLES W. LEAVITT,
Civil and Landscape Engineer.

New York, May 3.

Biological Action in Deterioration of Concrete in Sea Water

Sir—I enclose a few observations on the interesting discussion motivated by the article in *Engineering News-Record*, Jan. 20, 1921, under "More Observations of the Effect of Sea-Water on Concrete." The subject is of such importance and so complex that the more light thrown on it by personal investigation and observation of this subject may be instrumental in finding adequate means to minimize the evils attending the conservation of concrete structures, chiefly those in contact with sea water.

The attack on concrete constructions by sea water is not dependent on a single factor, but on the action of several elements co-ordinating to produce a rapidly deteriorating effect.

Whichever may be the elements entering into the composition of structures exposed to the action of sea water the disintegrating effects are similar, whether concrete, stone, brick, or other materials are employed.

The causes of deterioration of concrete structures are generally known, and are of several kinds. Let us take for granted that the mix is technically perfect, and that the structures are made in accordance with the best accepted rules. Soon after the structure gets in contact with sea water, marine growth of several species attaches itself to the surfaces penetrating the softer part of the concrete material. Lichens, fungi, and algae are the starters of this destructive work; this invasion of plant life is accompanied by that of lithophage organisms, of which some species can bore holes even in hard rocks, opening deep channels of attack to the chemical action of sea-water. In addition to these we find other agents of destruction in the numerous mollusca and cognate animal groups, secreting solutions of hippuric and sulphuric acids, which in the latter instance cause an active disintegration of silicates and aluminates forming the cement element of the concrete mixture. The ground is now admirably prepared for the chemical action of sea water on the silicates and silico-aluminates, and on the basic elements forming the cement. Among the constituents of sea water, sodium and magnesium chlorides attack rapidly the silicates. The sulphates, chiefly magnesium sulphate, is the most active constituent in sea water, and is taken up by the cement, forming calcium-sulpho-aluminate. The action of the first salt is accelerated in the presence of chlorides. Besides the foregoing instances of attack it must be added that concrete can also be disintegrated by the mechanical forces exerted by crystallization of salt in its pores.

The limit of penetration of salts and other corroding agents is not limited to 1 or 3 in.; it may progress from layer up to the metal reinforcement, where active oxidation will set in with consequent breakdown of structures.

The writer had occasion to observe for a number of years the action of oil on concrete skin. There is good penetration and it seems to confer a distinct protection against marine growth and also against the destructive action of sea water. A preliminary oil treatment may be suggested as a possible cure to some of the evils arising from the activities of marine organisms, and from the effects of sea water on concrete structures.

BAXERES DE ALZUGARAY,
Consulting Chemist and Metallurgist.

New York City,
April 28.

Service Factors of a Water-Works from Layman Viewpoint

FOURTEEN points or factors, each having different weight, are used by the Illinois Public Utility Commission in scoring the various water-works systems of the state. Quality, quantity and fire service do not tell the whole story. The commission asked twenty men to give their grading on these service factors. J. H. Mathews, service engineer of the commission, gave the following typical table in explaining the rating points at the recent joint meeting of the Iowa and Illinois sections of the American Water-Works Association.

TYPICAL SCORING OF AN ILLINOIS WATER-WORKS

Factors	Weight	Grade	Score
Quality	30	95	2,850
Continuity and pressure	24	90	2,160
Adequacy of fire service	11	20	220
Adequacy of capacity	8	80	640
Provision for emergency			
Construction and maintenance	5	85	425
Extension policy	4	60	240
Furnishing new services			
Handling complaints	3	50	150
Adjustment of bills—billing	3	70	210
Meter testing	2	10	20
Meter reading efficiency	2	80	160
Consumer's attitude	2	40	80
Records of pressure—interruption—station	2	40	80
Records of complaints	2	0	0
Records of meters and tests	2	30	60
Final grades	100	..	72.95

HINTS FOR THE CONTRACTOR

Water-Filled Canvas Hose Forms Temporary Dam

EXPERIMENTS by Norwegian engineers have shown the possibility of successfully damming shallow streams by means of a large canvas hose filled with water as illustrated by the accompanying views. The

FIG. 1. HOSE ANCHORED ACROSS STREAM FOR FILLING

dam illustrated was constructed Oct. 26, 1920, across the Skjaersjo River, Maridalen, Christiania.

Where the dam was located the stream is shallow and has a rock bottom. The hose used was of cotton canvas and was 35 m. (115 ft.) long and 2 m. (6.56 ft.) in diameter. It was laid across the river as indicated by Fig. 1, enclosed in a rope net anchored by cables to bolts set in the rock bottom about 20 m. (65.6 ft.) up and down stream from the hose. Both ends were also anchored to the shores. One end of the hose was temporarily closed by a plank clamp and the other end was left open and was slightly elevated for filling. The hose was filled with water run into the open end by a small hose laid far enough upstream to get a filling head of water. It required about 20 min., with a 20 cm. (7.87 in.) filling hose, to fill the large hose to the condition indicated by Fig. 2, which shows clearly the nature of the dam, about 6 ft. high, which was formed.

For more permanent structures it is contemplated that the hose will be filled with liquid mortar. The method, which is patented, has been planned for various other uses in engineering construction. Johan Störe, civil engineer, Christiania, Norway, is the inventor. E. Randers, 4401 Armitage Ave., Chicago, represents the system in America.

FIG. 2. HOSE FILLED AND DAM FORMED

Quick Construction of a Footway Under a Crowded Street

DENSE traffic in a narrow street was a factor in planning construction of a footway 12 ft. wide, 8 ft. and 80 ft. long to connect the concourse of the Union Station, Chicago, with a cab and taxi yard half a block distant, the depth being too slight to permit of tunneling. The purpose of the footway is to relieve the present congestion due to taxis taking passengers at the station entrance on Canal St.

In the first place, a building opposite the station was jacked up the height of one story and the basement made a part of the footway, the sidewalk being tunneled and an open incline extended about 80 ft. to the cab yard in the rear. The station sidewalk was also tunneled from the concourse.

Grader Rips Up Stone Block Pavement

W. J. FITZGERALD, contractor for the repaving of South St. near South Ferry, New York City, is using a Keystone grader, model Four 21 to rip up the 8-in. stone block preparatory to repaving the street with 5-in. stone block. The machine is the same as is

GRADER RIPPING UP STONE BLOCK

used on ordinary excavation, no changes being necessary to adapt it to its unique use.

In ripping up the old pavement, the hydraulic jacks are set and one front wheel and one rear wheel blocked to allow the digging boom and bucket to exert the maximum amount of pressure. As the stone block is laid on a sand bed, the grader operator merely forces the cutting edge of the bucket into the sand bed and a lift on the boom breaks up the block.

Motor trucks, loaded directly by the grader, carry away the block which is being recut for use elsewhere. The grader replaces at least twenty-five men. From 750 to 1,000 yards of stone are ripped up per day.

NEWS OF THE WEEK

New York, May 26, 1921

Tunnel Deadlock Continues

The deadlock on the Hudson River vehicular tunnel project, due to the "dismissal," by the New Jersey commission, of the board of consulting engineers and the refusal of the New York commission to recognize its authority for such action or to concur in it, continues at this writing. The matter will probably have to await an opinion by the attorney general of New York State as to the validity of the New Jersey body's independent resolution ousting the consulting engineers (see *Engineering News-Record*, May 12, p. 828).

At its meeting May 17 the New Jersey commission rescinded its action of May 3 appointing a "board of consulting engineers" of three members to advise it, and passed a resolution creating a "board of three technical advisors"—apparently a change only in the name of the new body. To the latter board George M. Wells and St. John Clarke were appointed at salaries of $10,000 each. No action was taken to fill the third place on the board left vacant by the refusal of Col. George L. Watson to accept appointment, as announced in last week's issue. Both Mr. Clarke and Mr. Wells have accepted appointment as New Jersey's technical advisers.

In a statement by Clifford M. Holland, chief engineer, the commissions were informed that the engineering department had practically completed the contract plans and specifications for the subaqueous portions of the two tubes and was ready, on authorization from the commissions, to call for bids on this work, according to the schedule in the chief engineers' 1920 annual report.

Compensation Report Approved by Am. Soc. C. E. Board

Endorsement was given to Engineering Council's committee report on classification and compensation of engineers by the board of direction of the American Society of Civil Engineers at its meeting April 24 in Houston, Texas. The proposed salary schedule is approved "not as an inflexible standard, but as indicative of the proper salary relation between the several grades of the classification; as proposing minima for the several grades which under ordinary circumstances are the least that can be considered reasonable and just, and as providing sufficient range between minima and maxima for making adjustments to suit variations in living conditions, kind of work and character of service, and for permitting adequate salary advances within the grades themselves."

Federal-Aid Road Act Amended

The Senate on May 16 amended the federal-aid road act so as to allow states in which the unappropriated public lands exceed 5 per cent to avail themselves of their allotments by appropriating smaller amounts of state funds. The bill was passed unanimously. It simply extends to the present fiscal year a provision which is contained in both the Townsend and Dowell bills, one of which it is hoped will be in effect by July 1. A similar bill was reported favorably but failed of passage at the last session. The Sells bill which passed the House at the last session contained an identical provision.

Eastern Superpower Plan Soon to Be Made Public

The superpower survey, authorized by the last Congress, is well along toward completion and the final report is expected by June 30. This survey of the possibilties of joining together in one interconnected line all of the electric power production of the northeastern section of the country has been in charge of W. S. Murray. The technical features of the plan are not causing as much difficulty as are the legal and financial, for while it can be shown that great savings will result from tying in all power lines in the district, the restrictions of state laws both as to export and import of power and as to profits of public utilities make difficult the questions of organization and promotion of any great power company.

Contend I. C. C. Has No Authority to Abandon Line

In a recent hearing before the Interstate Commerce Commission the Railroad Commission of Wisconsin, through its law examiner, A. H. Long, contended that the Interstate Commerce Commission has no authority to compel the abandonment of the branch line of the Green Bay & Western R. R. Co. into La Crosse. It is claimed by the Wisconsin commission that such action would constitute trespassing on state's rights and that the portions of the Transportation Act authorizing such action on the part of the Interstate Commerce Commision are unconstitutional. It is thought that the case may require trial before the Supreme Court. At this writing, no decision has been rendered by the Supreme Court in the Wisconsin case as to regulation of intrastate rates by the national commission. Forty-three other states supported Wisconsin in this action.

Senate Committee Starts Road Bill Hearings

July 1 Is Date Set for Having New Highway Law on Statute Books

Every effort will be made to have a new highway law on the statute books before July 1. On several occasions during the hearings in progress before the Senate committee Senator Townsend has expressed his determination to press his measure as rapidly as possible.

Thus far most of the witnesses who have appeared before the Townsend committee have been in favor of the Senate bill, although W. C. Markham, legislative representative of the American Association of State Highway Officials, confined his testimony largely to an explanation of the Dowell bill which the state highway officials favor.

Gray Silver, Washington representative of the American Farm Bureau, as this is written, is the only witness who has vigorously criticised the Townsend bill. His position is diametrically opposed to that of Senator Townsend in that he wants federal money so appropriated as to allow $1,000 per mile for each farm-to-market road in the country. It is contended that the Dowell bill represents the mean between these extremes.

George C. Diehl, representing the American Automobile Association, told the committee that he favors the Townsend bill because it recognizes the rights of the very wealthy states—states like New York, which have built and spent upward of $300,000,000 for highways—in that it provides for the construction of co-ordinating and connecting highways.

Commission Control Discussed

Senator McKellar expressed the opinion that a commission administration is frequently bad. "We would be in an awful fix if we had five presidents," he remarked. To this George M. Graham of the Pierce Arrow Motor Co. replied: "There is no essential difference between a highway commission in a state and a highway commission in the nation. The Secretary of Agriculture has said definitely that there is no way to conduct a highway system save by a commission."

Henry G. Shirley, engineer for Baltimore County, Maryland, in his testimony before the committee, said: "The width of the tire, the wheel load and speed are the three important things to control damage done to roads. We are getting isolated stretches of highway that are not connected. It is a patchwork. It is a disgrace. In some states

a state system has been laid out. In other states counties have been pauperized so that they will not be out of debt for a century."

Verbatim extracts from the testimony of Thomas C. Atkeson, representing the National Grange, are as follows: "The Grange believes that the time has come when all federal highway activities should be united in a single administrative department. There is probably no place where we can invest the taxes of the people more to their advantage than on the public highway, but this is limited to the extent that we can afford to pay the bill. The building of highways is going to involve the expenditure not only of millions of money but billions of money and ultimately hundreds of billions of money. The matter of administration is so gigantic that it seems to me that an independent commission which would have no other duties to perform would have its hands full in administering these federal activities in highway construction."

Will P. Blair, of Cleveland, among other things, told the committee that the great trouble about highway engineering in this country has been that we have had our minds directed wholly to the surface of roads. The injury to roads has suffered more from natural causes and lack of preparation than from traffic."

When the constitutionality of federal-aid legislation was questioned by one of the witnesses, Senator Townsend said: "There are three constitutional powers vesting in Congress this right to participate in the construction of roads. One is for the post offices and post roads. Another is for the national defense. The third is for the interests of interstate commerce."

At one point in the hearing Senator Townsend expressed uncertainty as to whether as much as $100,000,000 would be authorized as the Federal Government's contribution to road building.

OBJECTIONS FROM FARM INTERESTS

Mr. Silver listed his objections to the Townsend bill as follows:

(1) It creates a special commission at large expenses to administer federal funds, which we believe both unnecessary and extravagant.

(2) It gives exclusive power to the federal highway commission to designate the roads to be improved. It also determines the type, specifications and location of these roads although the states contribute at least one-half of the money.

(3) In providing for a 66-ft. right-of-way and a 20-ft. wearing surface the bill limits the construction of the roads to highways where there is a great amount of travel and does not provide for local construction or maintenance.

(4) The necessary costly construction required in this bill absorbs the state funds and thereby prevents construction and maintenance of connecting roads.

Overloading Trucks Condemned

The Merchants Association of New York, at a recent meeting, passed a resolution condemning the practice of overloading motor trucks and operating them at excessive speeds on the public highways. The association advocated a more rigid enforcement of motor vehicle laws.

Southwest Water Works Society Wants Operators School

Responsibilities of the water-works superintendent and how to educate him to meet them were stressed at the meeting of the Southwest Water Works Association May 9, 10, 11 and 12 at Oklahoma City. The Texas schools of two weeks' duration for operators were approved as was a measure by which the State of Oklahoma would provide $5,000 annually to educate operators in that state. Texas wants also to license operators.

Registration at the convention reached 250 and the average attendance at sessions was about 75. Discussions took more time than the papers and were entered into with enthusiasm by the many superintendents of the smaller plants. Following a paper on "Water Purification Methods" by C. Arthur Brown, a committee to revise methods of water analysis and standards of purification was appointed with instructions to confer with a similar committee of the American Water Works Association.

The main topics discussed at the six sessions were largely of interest to the superintendents of medium and smaller plants—state control, collections, regulations, reports, billing, operation needs, meter ownership and hydrant rentals. Representatives of the state boards of health of Texas, Oklahoma and Arkansas read papers outlining the needs of their boards and the meager financial support to meet them.

TECHNICAL PAPERS

One of the most valuable papers was on "Overhauling the Oklahoma Distribution System," by A. S. Holway, superintendent. The paper gave several instances of entire shut-downs due to lack of valves, or valves out of order when breaks in mains occurred.

A paper by H. V. Knouse described the ice business operated in conjunction with the Omaha Water Department, making an annual profit of $27,000 on an investment of $270,000.

Three prizes had been offered for the best record of collections for bills sent out. Seven contestants filed claims. The first prize was awarded to Winfield, Kan., which for a period of a year collected all of 60,000 bills with the exception of $1.55. The second prize went to Newton, Kan., for collecting 61,000 bills with the exception of one of $9, which was canceled because that particular bill was a public charge. Manhattan, Kan., won third prize, having collected all but $13 for 50,000 bills sent out. A remarkably high percentage was made by the others, including Omaha, 99.75 per cent and El Reno 99.85 per cent.

The secretary, E. L. Fulkerson, reporting expenditures of $2,383 with $294 cash on hand for the association, and for the *Journal* an expense of $749, with a cash balance of $221. More than 30 new members were admitted during the convention.

The newly-elected officers are as follows: President, J. F. Christy; vice-president, J. H. Patterson; secretary-treasurer, E. L. Fulkerson, Waco, Tex. The next meeting will be held at Hot Springs, Ark.

To Celebrate Ridgway's Promotion

A testimonial dinner to Robert Ridgway, in celebration of his promotion as chief engineer of the New York Transit Commission, will be given at the Hotel Pennsylvania, New York City, June 9 at 7 p.m., J. Waldo Smith, chief engineer of the Board of Water Supply, is chairman of the committee in charge of the affair. Tickets at $5 each may be secured from W. J. Buhrendorf, Room 2224 Municipal Building, New York.

Bonds Approved for Bridge Over Mississippi at St. Paul

By a bill recently passed by the legislature of Minnesota, Ramsey County is authorized to issue bonds for $900,000 for the purpose of building, maintaining and repairing a bridge across the Mississippi River at Sibley St., St. Paul. Congress has authorized the structure, but approval of plans has not yet been obtained from the War Department. The bridge will provide a new and direct connection from the business district of St. Paul to the stock-yard industrial district in South St. Paul. It will be necessary to build the bridge close to high water level, as the street passes through a subway under the tracks of the St. Paul Union Depot Co. about 150 ft. from the east bank of the river. This will necessitate some form of movable span for passing navigation. The county will co-operate with the city in building the bridge. Oscar Claussen is city engineer.

Joint Bridge Maintenance Subject to Commission Control

A decision just rendered by the Pennsylvania Public Service Commission establishes in effect that the obligation for maintenance of bridges in which railroads and cities or counties are jointly interested is subject to determination by the commission regardless of prior agreements between the parties. The decision was made in a case involving two industrial concerns, the borough of McKees Rocks, Allegheny County, the Pittsburgh & Lake Erie R.R., and a trolley line, and orders that the railway company make repairs to the structure, which had previously been declared unsafe, according to plans of the engineers of the commission. The county had disclaimed any interest in the structure, but is now required to pay a specified part of the cost. Amounts to be paid by the borough and by any electric railway company crossing the bridge after reconstruction are also fixed.

Commerce Chamber Committee for Unified Rail Operation

That the railroads, in order to re-establish firmly their financial stability, must make drastic reductions in operating expenses, notably in wages, and also must take measures to co-ordinate their services, principally in the terminals, are the conclusions reached by the railroad committee of the Chamber of Commerce of the United States in a report made public May 22. Emphasis is laid on the necessity of reducing operating expenses by increasing operating efficiency, and upon the fact that railroad wages must bear an equitable relationship to those paid in other industries.

The committee reports that every railroad company "must earnestly seek to adopt more economic methods of operation wherever changes in present practice promise to result in greater efficiency and economy. The first step toward the accomplishment of greater economies in the operation of railroads is the larger co-operation of the carriers with each other in the performance of their services. In terminal organization and management the co-operation of the carriers is especially urgent, and in this field undoubtedly many economies can be brought about."

Canadian Government Appoints New Grand Trunk Directors

The Canadian Government has appointed directors of the Grand Trunk properties in accordance with the act recently adopted giving the government control of the system, as noted in *Engineering News-Record* of May 12, p. 830. The following appointments to the government directorate have been announced: Sir Joseph Flavelle, Toronto; Howard G. Kelley, present president of the Grand Trunk Railway Co., Montreal; A. J. Mitchell, vice-president, Canadian National Railways, Toronto; E. S. Newcombe, Deputy Minister of Justice, Ottawa, and J. N. Dupuis, dry goods merchant, Montreal. The appointment of this board is understood to be temporary, preparatory to the bringing into force of the Canadian National Railways Act providing for the unified management of the government railways, but some of the temporary appointees are expected to be selected as members of the permanent board.

Housing Advisory Body Meets

An organization meeting of the advisory committee on housing appointed by Secretary of Commerce Hoover, as reported last week (p. 874), was held on May 16 and 17 at Washington. It was decided to enlist the advisory assistance of national engineering and similar organizations in order that the ultimate object of the commission's work, to aid in housing development, may be attained in the best and most rapid manner. Frank P. Cartwright of Rochester has been engaged as secretary to the commission.

Water and Sewers for Arlington Sanitary District

A report outlining plans and giving estimates for water supply and sewerage system, including treatment in each case, for the Arlington Sanitary District, comprising Arlington County, Va., adjoining the District of Columbia, has been submitted to the supervisors of Arlington County by David J. Howell & Son, civil engineers, Washington, D. C. The estimated cost of the first units proposed for construction is $1,026,000 for the water project and $225,000 for sewerage, but this includes only a part of the entire contemplated construction. It is recommended that all or nearly all of the water be metered. Sewage treatment would be by bar screens and sedimentation. The population of Arlington County was 16,040 in 1920 and the estimated population in 1950 is 38,700.

Power Commission Considers Other Water Rights

After listening to testimony from several witnesses, the Federal Power Commission on May 16 decided a further hearing would be necessary in connection with the application of C. E. Loose for permission to install a power development on the East Walker River in California, just across the Nevada boundary. The applicant proposes to use the power developed for mining purposes.

Irrigation interests appeared in opposition to the application, stating that the site could be used to better advantage for the storage of irrigation water. It was said that 12,000 acres of land could be made productive by devoting the water to their purposes. It was contended that the public would benefit immeasurably more by the irrigation project than by allowing the development of power in an arid region such as the one in question.

Chicago Engineer Reinstated

The Chicago city civil service commission has reinstated Thomas G. Pihlfeldt, city bridge engineer, who was dismissed last year on charges which led to a protest by the American Association of Engineers against the charges themselves and the manner of trying the case. (See *Engineering News-Record*, May 13, 1920, p. 937, and Aug. 12, 1920, p. 334.) The reinstatement is said to have been made on the recommendation of the commissioner of public works.

Engineer Corps to Get 7 Per Cent of West Point Graduates

A trifle less than 7 per cent of the officers who will be graduated from the United States Military Academy in June may be commissioned in the Corps of Engineers. The distribution of the commissions issued West Point graduates is based on the relative commissioned strength of the various branches of the service.

Recommend New Water Commission for Kansas City

Progress toward a new water supply for Kansas City was marked recently by a report of the Water Supply Committee ("Committee of 25") recommending a new administrative commission to take over the existing system and handle the proposed new work. The commission would consist of four members, two from each major political party. It would have authority to issue bonds, hold office for six years, receive $6,000 per year until the work is constructed but not longer than six years and would be named by the mayor before the bond and amendment election is held (probably in August). On the last point depends the outcome of the election because many organizations will work for the issue only if they know what the personnel of the commission is going to be.

The cost of the project, as recommended by Fuller & McClintock, consulting engineers, was $18,000,000, which was stated to be based on a ratio of 2.25 as compared with pre-war costs. The committee holds that the present ratio is 1.75, as evidenced by the U. S. Steel Corporation prices which are on a 1.63 basis and cement on a 1.75 basis in the Kansas City market. Within the 6 to 8 years required to build the new works the committee anticipates the lowest average price will reach a 1.25 ratio. On this basis it believes $11,000,000, or an average of 1.4 times the pre-war cost, will be sufficient.

With the consulting engineers, the committee agrees that the Missouri is the best source, that the water must be be filtered, that the present site and one in Missouri adjacent to the Platte-Clay County line are both practicable. Although the latter is favored, it is the committee's opinion that final decision should be left to the commission.

Engineers, individually and through the Kansas City Engineers Club, are co-operating with the Citizens Committee of Twenty-five.

Reorganization of Indiana Public Service Commission

Following the appointment of E. I. Lewis, chairman, Public Service Commission of Indiana, by President Harding to the Interstate Commerce Commission, the Indiana body was reorganized with J. W. McCardle, formerly a member, as chairman. The remaining personnel is as follows: Edgar Blessing, Maurice C. Douglas, George M. Barnard and Glenn Van Auken, commissioners, and L. C. Loughry, secretary. All are attorneys and new appointments except Mr. Van Auken, a court reporter.

No decided changes in policy are contemplated. Only one department head has been changed, Carl W. Wilde replacing M. D. Atwater as director of service. H. O. Garman, chief engineer will continue his duties with the new commission.

Indiana Court Decision Supports County Surveyor

A decision affecting county surveyors of Indiana was given recently by Judge T. W. Hutchinson, in the Clay circuit court, in the case of Frank E. James, surveyor, vs. Ralph H. Kattman, engineer and former county surveyor, and others, in favor of the plaintiff. Mr. James had sought an injunction to stop payment of money to Mr. Kattman for work on roads, to which project he had been appointed as engineer by the board of commissioners.

Several road petitions were acted on under the administration of Kattman, as surveyor. The commissioners asked Kattman to delay the work on account of finances, with a promise, it was said, that he would be appointed engineer on the roads, the fees of which would have amounted to approximately $15,000. Kattman was defeated in the Democratic primary election for the nomination, and James, a Republican candidate, was elected. James found the office an empty one, as the commissioners had appointed Kattman engineer on most of the roads to be built. James then brought suit to obtain the work which, he asserts, goes into the office of surveyor.

As a result of the ruling, Kattman will be compelled to turn over to the surveyor all papers and documents in connection with the roads on which he had been appointed engineer. Eleven roads, totaling more than 25 miles, are involved.

Public Health Association Moves to New York City

The headquarters of the American Public Health Association were moved from Boston to the Penn Terminal Building, 7th. Ave. at 31st St., New York City, May 1. Quarters on two floors will be occupied by the association together with eight other organizations having to do with public health matters and a liaison office of the United States Public Health Service. A common service committee has been formed and a joint library service is under consideration. The bringing together of these various health organizations is, in part, the sequel of the formation of the National Health Council in December, 1920.

Jamaica Bay Development Plans Approved by City

Plans, specifications, form of contract, and estimates of cost for dredging a channel at Mill Basin, Jamaica Bay, in New York Harbor, and for the building of a bulkhead were approved by the Board of Estimate of New York City May 13, following its authorization of April 1 for the expenditure of $750,000 for bulkheading Mill Creek to extend Flatbush Ave. across to Barren Island. Construction will be carried out under the Department of Docks of New York City, which drew the plans and specifications for the work. Dock Commissioner Murray Hulbert has announced that by June 1 it is expected to have dredges working on the channel.

The extension of Flatbush Ave. across to Barren Island will start to make available the 1,600 acres of city land which it is intended ultimately to develop as a deep water terminal site for which the Dock Department has made tentative plans for five piers, 800 ft. wide and 1,000 ft. long.

Authorize Construction of Two Short Railroad Lines

On May 14 the Interstate Commerce Commission issued certificates authorizing the construction by the Uintah Railway Co. of a line approximately 19 miles long northward from its present terminus at Watson, Utah, and by the Detroit & Ironton Railroad Co. for a line 15 miles long from Springwells to Fordson, Mich., on the western outskirts of Detroit.

In both cases request for authority to retain excess earnings, as provided in the Transportation Act, was granted.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN WATER WORKS ASSOCIATION, New York; Convention, Cleveland, June 6-10.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston. Annual meeting, San Francisco, June 14-15-16.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual meeting, Asbury Park, N. J., June 20-24.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh, Pittsburgh, Pa.; Annual Convention, New Haven, Conn., June 28-July 1.

The Engineers Club of Seattle, Wash., was addressed on April 15 by Dr. Yutaka Minakuchi on American-Japanese relations.

The Colorado Engineering Council is considering a project for an engineering building at Denver, Col. Resolutions of endorsement have been passed by the Colorado Society of Engineers.

The American Society of Mechanical Engineers announces the election to honorary membership of Henry R. Towne, head of the Yale & Towne Manufacturing Co., and Nathanial G. Herreshoff, naval architect and yacht designer.

The Rochester (N. Y.) Engineering Society, at its meeting, May 13, elected Edwin A. Fisher to honorary membership. Mr. Fisher has been in the city service for many years as city engineer and is now serving as consulting engineer and superintendent of Rochester's city planning bureau. At the same meeting the project for the affiliation of all of the local engineering organizations at Rochester was discussed. If the plan materializes there will be created a council composed of the presiding officers of the Rochester Engineering Society, the local sections of the national societies of electrical and mechanical engineers, the American Association of Engineers, the Rochester Society of Architects, and the Rochester Society of Technical Draftsmen.

The New York Section, Am. Soc. C. E., at its meeting in New York City May 18, elected Nelson P. Lewis, formerly chief engineer of the New York Board of Estimate and Apportionment, president and J. P. J. Williams, of the staff of the secretary of the American Society of Civil Engineers, secretary. Charles Gilman and Joseph J. Yates were chosen as directors.

The Iowa Engineering Society recently voted by letter ballot, 221 to 11, to join the Federated American Engineering Societies. The choice of the next annual meeting, also determined by letter ballot, resulted in 153 votes for Sioux City and 57 for Cedar Rapids. An employment service, recently initiated by the society, is handled by L. A. Canfield, secretary, Flynn Building, Des Moines.

PERSONAL NOTES

CURTIS Y. CLAWSON of Salt Lake City, has been appointed district engineer for Weber County, Utah, in charge of state road work.

NATHAN H. BAIER has resigned from the division of sanitary engineering, New York State Department of Health, to become operator and chemist with the new water purification plant at West Palm Beach, Fla.

HARTLEY ROWE, manager of the Detroit office of Lockwood, Greene & Co., engineers, has been made district manager of the Boston, Mass., office, succeeding Kenneth Moller, who was recently elected into the firm of Lockwood, Greene & Co.

D. C. FENSTERMAKER, district engineer Chicago, Milwaukee & St. Paul Ry., has been granted a leave of absence to become associated with Peterson Brothers, Omaha, Neb., contractors, who will construct a new branch line in Cuba for the United Fruit Co.

EDWARD R. KNOWLES, consulting engineer and fuel expert, is now associated with Murrie & Co., Inc., New York, in charge of pulverized coal and gas fuel engineering work.

A. B. HARGIS, formerly senior assistant engineer with Morris Knowles, Inc., Pittsburgh, has been appointed

city engineer and superintendent of waterworks of Jellico, Tenn.

FRANK H. WILSON, recently general superintendent of the third district, New York Central R.R., with headquarters at Cleveland, Ohio, has been elected president and general manager of the Cleveland Southwestern & Columbus Ry.

RALPH D. BALLEW, recently manager of the Grand Rapids, Mich., office of the Westinghouse Electric & Manufacturing Co., and before the war, city manager of Reidsville, N. C., has been appointed city manager of Grand Rapids.

DWIGHT PORTER, professor of hydraulic engineering, Massachusetts Institute of Technology, has resigned effective Oct. 1. He has been connected with the institute since 1883.

F. P. OBEE has resigned as chief deputy county engineer, Toledo, Ohio, to enter the highway and bridge contracting business with W. C. Stone at Ontario, Ore.

EDWIN R. QUIMBY, formerly chief engineer of the Consolidated Telegraph and Electrical Subway Co., New York City, and since then with All-American Cables, Inc., on special work in Mexico, has been appointed chief engineer of the International Clay Products Co., New York, and its subsidiary companies.

C. M. TALBERT has resigned after about twelve years of service as director of streets and sewers of St. Louis, Mo., to engage in a partnership in an insurance business.

C. H. FISK, in 1914 assistant sewer commissioner of St. Louis, Mo., and later chief engineer of construction for the city, has been appointed director of streets and sewers to succeed A. M. Talbert, resigned. During the world war he entered the construction division of the army as a major and was assigned to duty on warehouse buildings at Boston, Mass., and Brooklyn, N. Y.

PROF. HENRY P. TALBOT, head of the department of chemistry, has been named acting dean of Massachusetts Institute of Technology. Prof. Talbot was graduated from the institute in 1885. In the same year he became an assistant at the university, later an instructor, assistant professor, professor and since 1902 has been professor of inorganic chemistry in charge of the department of chemistry and chemical engineering. He is at present chairman of the faculty.

COLONEL H. W. CROCKER, who has been acting secretary of the American Society of Civil Engineers since the retirement of Dr. Hunt, and who was recently relieved as acting secretary by the election of E. M. Chandler, has left New York for Denver where he will resume his practice as consulting engineer. Colonel Crocker was in consulting practice in Denver for many years before the war and left there in order to accept a commission in the construction division of the army. His major assignment during the war was in charge of the construction of the Brooklyn army base.

LOUIS D. BLAUVELT has been appointed engineer for the Colorado State Highway Department.

JOHN J. SWAN, for the past two years with the Prest-O-Lite Co., Indianapolis, Ind., is now associated with the Engineering Business Exchange, New York City.

HOMER J. FORSYTHE, manager of the construction division of the engineering department of the E. I. DuPont De Nemours & Co., Inc., Wilmington, Del., has been transferred to the position of assistant general manager of the Hyatt Roller Bearing Co., Newark, N. J., a subsidiary of the General Motors Corp.

OBITUARY

THOMAS L. SMITH, founder, director and chief stockholder of the T. L. Smith Co., died April 29 in Milwaukee, Wis. He was born in England in 1855 and was graduated from Iowa State College in 1877. He later completed his engineering education at Massachusetts Institute of Technology. In 1920 Iowa State College conferred upon him the honorary degree of Doctor of Engineering. His early life was spent in drafting and engineering work with some of the large manufacturers of Milwaukee, including Allis-Chalmers Co., Filer & Stowell Mfg. Co., and C. J. Smith & Sons Co. Mr. Smith's interest in concrete mixers developed in 1898 and 1899 when he conducted a school of engineering and mechanical drawign in Milwaukee. In 1899 he invented the Smith tilting mixer and the first machine was manufactured in 1900. In 1905 he organized the corporation today known as the T. L. Smith Co., with assets of over $1,200,000. He developed the Sterling Wheelbarrow Co., West Allis, Wis., from a small concern to the largest and most successful of his holdings at the time of his death. The Smith Engineering Works, Milwaukee, manufacturers of Telsmith rock and ore crushers was also organized by Mr. Smith.

WILLIAM H. DAVISSON, for the past seven years assistant district engineer in the office of the Pacific District, Bureau of Valuation, Interstate Commerce Commission, San Francisco, Cal., died in Oakland, Cal., May 3. He was born in Kalamazoo, Mich., in 1862 and he was educated at Griswold College, Davenport, Ia. He entered the service of the engineering department of the Chicago, Rock Island & Pacific Ry. as chainman, later he became general roadmaster and, in 1906, assistant chief engineer. In 1907 he entered the service of the Chicago, Milwaukee & St. Paul Ry. in charge of construction work on the Puget Sound extension in the vicinity of Missoula, Mont. In 1910 he was appointed principal assistant engineer of the North Coast Railway, now a part of the Union Pacific System. In 1914 he was appointed field engineer by the Bureau of Valuation, Interstate Commerce Commission, in charge of roadway inventories of railroads in the Pacific District. Later he was promoted to assistant district engineer, which position he held at the time of his death.

FREDERICK W. DAGGETT, superintendent of the Trenton, N. J., filtration plant, died May 10 in Trenton. He had been connected with city water filtration plant since 1913, entering its service as erecting engineer.

DR. EDWARD B. ROSA, chief physicist of the U. S. Bureau of Standards, died May 18 in Washington, D. C. He was born in Rogersville, N. Y., in 1861 and was graduated from Wesleyan University in 1886. He received the degree of Sc.D. in 1906 from this university and the degree of Ph.D. from Johns Hopkins University in 1891. From 1891 to 1901 he was professor of physics, Wesleyan University. In 1901 he became connected with the U. S. Bureau of Standards as physicist and, later, was appointed chief physicist. He contributed to American and European journals of physics and electricity and the publications of the Bureau of Standards. He was in charge of the electrical division of the Bureau of Standards including investigations on standards of service and safety for public utilities. In the World War Dr. Rosa developed a number of scientific instruments of great value, among which were a sound-ranging device for locating big guns, the geophone for detecting mining operations and the development of aircraft radio apparatus.

FRANKLIN K. LANE, Secretary of the Interior for seven years, during the Wilson administration, died May 18 in Rochester, Minnesota. He was particularly proud of the fact that he was in charge of more engineers than any other administrative official, either public or private, in the world. While his position precluded his taking an active part in the campaign for a Department of Public Works, he made no secret of the fact that he approved such a step and he did much to encourage the movement. While not an engineer himself, he was firmly of the belief that the Secretary of the Interior, or the Secretary of Public Works, as he would like to have had it, should be an engineer. He frequently expressed his admiration for engineers as a class. On numerous occasions he declared that for result getting and thoroughness, the engineering profession led all others.

Business Side of Construction

Facts and Events that Affect Cost and Volume

National Conference Board for Building Industry Proposed

Establishment of a national conference board of the building industries is expected to result from a discussion of the matter before Secretary of Labor Davis in Washington May 11. The executive board of the Associated General Contractors of America adopted a resolution urging the establishment of such a board. The purpose is to have the board study working conditions, production, waste, costs and other matters which have a general application to the building industry. Secretary Davis, following the outline of the resolution, promised to appoint a committee to draw up tentative plans providing for the creation of such a board and to outline its activities. He will appoint three members to the committee from each of the following groups: Associated General Contractors, American Institute of Architects, American Engineering Council, the public and the building trades department of the American Federation of Labor.

The tentative plan is to be submitted within thirty days. Within ninety days, Secretary Davis will call a general meeting, at which time final consideration to the plan will be given.

Municipal Supply Scheme in London

(London Correspondence)

A scheme for inter-municipal trading on a large scale is under the consideration of the standing joint committee of the London boroughs. Under this scheme it is intended that the local authorities will become engineers, iron and brass founders, pavement makers, brick makers and colliery owners and producers and distributors of all kinds of materials used by municipal authorities. The various boroughs are to apply for Parliamentary powers to establish depots for mutual supply and for purchasing on a co-operative basis. The scheme includes all kinds of building materials, road materials, metals, stoneware, stone, gravel, cement, tar and timber.

April 1921 Automobile Shipments 70 Per Cent of April 1920

According to information given out by the traffic department of the National Automobile Chamber of Commerce, reports from factories representing three-quarters of the total automobile production indicate that the shipments for the month of April exceeded the previous month by approximately 27 per cent. The April, 1921, shipments were, it is estimated, at least 70 per cent of the figure attained in 1920.

Low Bid on Cleveland Reservoir Is $2,205,248

Thirteen contractors submitted bids for the construction of the 125,000,000-gal. concrete reservoir which is to serve both as a clear well for the Baldwin filtration plant to be built and as a distribution reservoir for the low-service district of Cleveland, Ohio. The low bidder was the Mellon-Stuart Company, Pittsburgh, the low bid being $2,205,247.90. The high bid was in excess of $2,800,000, or 31 per cent above the low bid. The engineer's estimate for the work was $2,250,000.

Notable in the unit prices were the bids upon concrete for various purposes. In concrete for wall foundations the per cubic yard bid of the low bidder was $11.78 and the unit prices of all bids ranged between $10.99 and $16.95 per cubic yard. On concrete for walls, pilasters and conduits a low unit bid of $12.20 per cubic yard and a high bid of $18 per cubic yard were registered. In concrete for sub-floors and column foundations the low bid was $9.87, the high bid being $17.04 per cubic yard. Bids for concrete for groined and barrel arches ranged between $17.04 and $28, the Mellon-Stuart bid for this type of work being $19.81. For concrete floors, the low bid was $11.15.

There are forty-two items included in the work, the largest of which are as follows: Concrete, 114,100 cu.yd.; reinforcing steel, 3,500,000 lb.; fill and embankment, 120,000 cu.yd.; tile drains, 26,000 lin.ft.

The Guild of Builders in England

(London Correspondence)

The British Minister of Health has stated in Parliament that approval has been given as an experiment to the carrying out of thirteen housing schemes under the building guild system. At the present it is not proposed to extend this system, not because the government has any hostility toward the guilds but, unless building guilds can erect dwellings on an economic basis, they will not be employed. It has been stated in Parliament that under the system of building by direct labor each brick laid costs 1 shilling.

On one estate, near Manchester, it is estimated that each house built by the guild costs £120 less than when built by private contractors. In another district, Heywood, the housing committee recommended the acceptance of the tender for houses submitted by the guild which was £26,000 below that of the local builders and £16,000 below one submitted by another housing contractor.

A meeting of the Manchester trades unions is shortly to be held to consider the practicability of the extension of the building guild system.

The Present and Future of the Building Industry

Trend in Contracts Let This Year—What the Construction Needs of Industry Are

Construction work is essentially dependent upon the necessity for the extension of public works, upon increased requirements of transportation interests, including those pertaining to highways, upon the need for added office and housing space, and upon the ability of basic industries to expand, due to the increased demand for manufactured products. When any slump in business occurs the contractor is among the first to suffer, inasmuch as lack of business means lack of extensions and the practical cessation of all building. Therefore, the contractor today is spending a great deal of time investigating the opportunities for keeping his organization busy which this and that field of construction offers.

What the future is in these various classes of construction can best be found out by analyzing the trend in contracts let so far this year and by appealing to the various industries for information as to future plans. No account will be taken here of the influences of labor and materials on, or the attitude of financial interests toward, construction work.

Analysis of Contracts Let

Analysis of the contracts let, as reported in *Engineering News-Record*, for the first four months of 1921 reveal at least three well-defined situations: First, that industrial building, aside from a general program of steel and concrete garage building, is not to be compared with the activity noted during the early part of 1920; second, that the building of apartment houses, educational institutions, churches, bank and office buildings, and theatres and other amusement places, has this year shown marked activity; and third, that street and highway construction is not far behind the 1920 program. The extreme lack of public educational facilities due to inaction in that class of building during the war years, has led to a great amount of public school building within the past few months. Within the past few weeks considerable impetus has been given to apartment house construction, the most notable increase in this class of work being noticed in New York City, where a tax exemption ordinance became effective more than two months ago. This miscellaneous building, including the classes of construction mentioned above, has been going on during the past three months at the rate of $50,000,000 per month or more, the greatest activity having been noticed during the past month, when, for three successive

weeks the value of contracts let ranged between $12,000,000 and $15,000,000.

Highway construction has been and apparently will continue to be for the season carried on extensively by the larger and more populous states. New York, Pennsylvania, Ohio and Illinois are the states leading in this class of work, though less extensive programs of highway development are being carried out systematically by many other states. Though New York suspended its highway construction program during the 1920 season there has been enough of a recession in prices to make it worth while for that program to be actively carried out this year. In New York contracts have been let on practically every bid so far advertised this year and for from 85 to 90 per cent of the estimates made by the engineers. Considerable extensions in county highway work have also been noted. On the other hand the repaving programs of municipalities have not been as large as apparently they should be to overcome the inactivity of war years. Street and road construction has been going on during the past four months at a rate of from $35,000,000 to $45,000,000 per month, which, under the present circumstances, is considered not unsatisfactory when it is remembered that approximately $750,000,000 represents the approximate total available for road construction this year.

Public works construction is recovering slowly. There is apparently plenty of funds with which to carry on large programs of sewer and water supply construction. Some municipalities have made extra efforts to begin and prosecute vigorously public works construction programs in order to relieve local unemployment. Despite apparent backwardness public works extensions cannot be deferred much longer without seriously endangering the public health.

Industrial Building

In industrial building, extensions in factory and warehouse space for the automobile industry are not expected, at least during the coming 18 months. Most of the automobile factories were considerably extended during the war and the changing over of much of this war-factory equipment and space was not entirely accomplished until late in 1920. That space then became available for the manufacturers of automotive vehicles. Unless the unexpected happens from a sales end, not all of the space thus provided will be needed during 1921

Inseparably associated with possible demand for expansion of textile manufacturing facilities must be opinions and evidences as to demand for manufactured products. Not long ago a man who is very close to conditions in the textile industry asserted that "the textile industry is experiencing the most remarkable come-back in its history. Every mill isn't running to 100 per cent capacity, but by far the majority of mills have sold enough merchandise to keep them comfortably engaged for some months to come. It is generally conceded that the normal demand for American-made textile products is in excess of present facilities to produce. On this basis, therefore, I think it can be safely stated that the textile industry will show an approximate increase for the next few years of about 250 new plants annually."

No great amount of building in the machinery industry is expected within the next few years. Some builders of electrical machinery, many builders of printing machinery and a few producers of textile machinery have been kept fairly busy, but otherwise the industry is working on short time. The majority of machine-tool builders find themselves with large, modern plants equipped with up-to-date machinery but little prospect of securing enough orders in the near future to occupy the plants to capacity. The tremendous expansion in the manufacturing capacity of the machinery industry during the war has made it unlikely that considerable extensions will be made in the next few years.

Metals, Chemicals and Coal

The serious drop in the metal market has made it impossible to give any forecast of new construction in the metal-producing industry. While the present depression exists financing of new projects will be difficult. At present several large companies have important programs under way, but these were practically all entered upon before the metal market dropped. Various small construction jobs are also under way, but these are comparatively unimportant.

In the chemical and related industries much of the construction carried on during the war was of a temporary character which undoubtedly will have to be replaced with permanent structures. On the other hand these industries were much overbuilt as a result of the expansion during the war and it is true that many structures have since been sold for other purposes. Nevertheless the chemical industry is adhering to its slogan that "it is never built but always building."

Construction and development work in the bituminous coal mining industry is below normal and is confined almost entirely to the work on properties of the larger and stronger companies. There was a great expansion in 1920 among the smaller operators, the majority of whom are not operating at all now, or only for a few days a week. New incorporations are no more in number now than last year, nor in any year, and not all these new incorporations finally result in construction and development of mines but many do, and new mines are being opened in every field to meet the inevitable need for replacement of property worked out and abandoned. In the anthracite industry construction and development work is proceeding practically on a normal basis.

Water Movement of Western Lumber to Atlantic Ports

Pacific Northwest lumber shipments through the Panama Canal to Atlantic Coast markets increased 3,435 per cent the first quarter of 1921 as compared with the same period of 1920, according to a report recently issued by the West Coast Lumbermen's Association. During the first three months of 1920 only 1,202,229 ft.b.m., of Pacific Northwest lumber were shipped to Atlantic Coast points by water, although at that time west coast mills were shipping to those markets more lumber than had ever before been sent east of Buffalo and Pittsburgh. For the first three months of 1921 Atlantic Coast cargoes of Pacific Northwest lumber totaled 42,495,579 ft.b.m.

Maricopa County Considers Building Cement Plant

Maricopa County, Arizona, is considering the construction of a cement plant with a rated daily capacity of from 1,000 to 1,200 barrels. Whether the county can legally operate a plant in competition with private concerns is a question which the county attorney is now investigating. A bill passed by the last legislature authorized the issuance and sale of bonds for the construction and maintenance of industrial plants, which gives Maricopa County authority for construction of a cement plant for public building only.

It is believed there is ample room for a plant constructed and operated by public money, inasmuch as during 1919 the total state consumption was 366,000 barrels and in 1920, 515,000 barrels. If legal, it is possible that the plant will be constructed partly with public money, then leased to a private company to operate with the provision that the county be furnished cement for a certain period at a price 5 cents per barrel in excess of the production cost.

Wholesale Prices Fall

A further decline in the general level of wholesale prices was noted during April according to information gathered in representative markets by the United States Department of Labor through the Bureau of Labor Statistics. The Bureau's weighted index number dropped from 162 in March to 154 in April, a decline of approximately 5 per cent. The April figure is nearly 42 per cent below that of April, 1920, and about 43½ per cent below the high peak of last May.

New York Price of Dynamite Same as in April

Through a typographical error, 40 per cent gelatin dynamite was quoted at 22¾c. per lb. in New York, instead of 32¾c., in the Monthly Prices of Construction Materials in the May 5 issue of *Engineering News-Record*. On March 3 the price was 33¾c., and since our issue of April 7, 32¾c.

Building Trades of Philadelphia Eager to Improve Status

Through its committee on education and information the Council of Associated Building Trades of Philadelphia and vicinity is carrying on a campaign of education whereby it hopes to strengthen its organization and impress upon the minds of the public that it is a thoroughly responsible institution. The organization is endeavoring to cooperate with the Master Builders' Exchange in Philadelphia in the settlement of all questions of mutual interest with the smallest loss of time and effort. In addition, certain educational courses are given, in order that the efficiency of the individual workmen may be increased through added knowledge and experience.

The efforts of the trade unions to make their organizations more attractive to the nonunion men, to improve

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That the BRICKLAYERS of Philadelphia

maintain a General Committee for the promotion of the art of bricklaying, which includes the following sub-committees?

1. Health and Safety.
2. Materials and Methods.
3. Efficiency and Production.
4. Co-operation(with Architects, Engineers, Contractors and Manufacturers)
5. Statistics (as to wages, working conditions, etc.)
6. Public Information
7. Elimination of Unemployment
8. Education and Information of Apprentices and Journeymen.

Our General Committee and Sub-Committees stand ready at all times to assist the public either in an active or informative way. We want you to understand that our purpose is to serve the public to its best interests and to our mutual satisfaction.

There is great need for and we will welcome an engineering analysis and survey of our industry to overcome intermittent employment, which will prove the fairness of our position regarding wages and living conditions.

Bricklayers' Local No. 1
707 N. Broad Street
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their status, to increase the efficiency of their members and otherwise establish the public confidence in organized labor have been greatly aided by the co-operation of architects and others inspired by the efforts and vision of G. Knickerbacker Boyd, a Philadelphia architect.

Included in the program of education of the Philadelphia union are certain suggestions made at a recent conference of the building industry called by the industrial relations committee of the Philadelphia Chamber of Commerce, by W. S. Hays, a Philadelphia industrial engineer and consultant on industrial relations. How the unions might improve their status was summarized by Mr. Hays as follows:

(1) Obtain the confidence of the buyers by proving that the water is out of 1920 peak wages, if it is.

(2) Develop the small job market to stabilize employment.

(3) Remove any union rules and any other restrictions which may be causing unnecessary costs and delays.

(4) With employers and material men co-operatively strive to lower unit costs and devise better methods.

(5) Educate building trades to a pride in craft.

(6) Develop a classified wage incentive system above the basic minimum wage to attract new men to the building trades and give all the impetus to become efficient and proficient workers.

(7) Create with employers a tribunal or board jointly maintained which will develop industry as a whole and eliminate waste of the unemployment in building trades by promoting year round construction programs and coordination of new public and private construction with maintenance and repair work.

Several of the various locals included in the Council of Associated Building Trades of Philadelphia are carrying on extensive advertising campaigns to increase their number. For instance, Bricklayers' Local No. 1 maintained a general committee for the promotion of the art of bricklaying, including the subcommittees noted in the advertisement running in the local newspapers, a facsimile of which is shown herewith.

City of New York Will Not Pay Contractors' Claims

Although a bill was recently passed and signed by Governor Miller empowering the city of New York to pay claims filed by subway contractors for additional costs due to increases in wages and materials incident to the war, the city does not intend to pay any of the claims, according to the assistant corporation counsel. Such claims put in by contractors exceeded $7,000,000.

The new law signed by Governor Miller amends the Walters act of 1918 and a subsequent act introduced by Senator Charles T. Lockwood, which was passed to facilitate completion of contracts by granting relief. The act affords no opportunities to recover profits.

Car Loadings Decrease

Reports received by the car service division of the American Railway Association from the railroads of the United States showed a decrease of 3,972 in the number of cars loaded with revenue freight during the week ending May 7. Total number of cars loaded was 718,024, 125,000 below the number for the corresponding week in 1920, and 35,000 below the figure for the corresponding week of 1919.

Increases were reported in the loading of grain and grain products, live stock and ore, but decreases in coal, coke, forest products and merchandise and miscellaneous freight which include manufactured products. Decreases were reported compared with the corresponding week of 1920 in the loading of all commodities except grain and grain products, merchandise and miscellaneous freight.

Deferred Construction Extensive

In a meeting of the executive board of the Associated General Contractors of America, Frederick L. Cranford, vice-president of the A.G.C., had the following to say regarding the outlook in the construction industry:

"We believe that in the present industrial depression the construction industry is an important factor, because it is not only a preliminary step to any new development or enterprise, but because there is a vast delayed program to be performed. Ten years or more ago, E. H. Harriman stated the railroads were in need of an expenditure of a billion dollars a year for five years; that expenditure has not been made and it is probable that the need today is for even a greater amount.

"Hydro-electric development has been retarded, due to the withdrawal of all public lands from entry for such use some fourteen years ago.

"The development of all public works and utilities was largely stopped upon our entering the war, and financial difficulties have prevented any considerable extension of them since.

"Reclamation and irrigation projects have been quiescent since 1914.

"With 1,100,000 young men reaching the age of 21, and somewhat less than that number annually being married, it seems safe to estimate that during the last six years there has accumulated a housing shortage of over a million, possibly a million and a quarter homes.

"Adding the delayed public works of our cities, and states, roads, terminal facilities, docks, warehouse, factory, home and business building construction, canals, and waterways, it is quite easy to figure a delayed construction program in the United States of $15,000,000,000."

Ex-Service Men in British Building Trades

(London Correspondence)

The government scheme for the absorption of 50,000 ex-soldiers into the building trades, which has been approved by the building employers, provides that the scheme shall be worked through local committees made up of members of the Association of Master Builders, and if the unions agree to the scheme, of representatives of the various trades unions. These committees will select men from the register of their local employment bureaus and will advise on that branch of the trade in which each candidate is likely to show most promise.

A two-years' contract of service will then be made between each man and his employer, with a clause that the contract may be broken after a three-months' probationary period should either party be dissatisfied. Another clause provides that the candidate may be transferred, with his consent, from one employer to another. An employee may, at any time during his two years' service, apply to his employer for a

service, apply to his employer for a proficiency certificate, which will entitle him to a higher grade of pay. Each district committee will deal with any compaints and will supervise, in a general way, the service contract.

These rates will be in force under the government scheme:

1. For first six months of contract, 50 per cent of the district skilled rate plus 10s. per week.

2. For second six months, 65 per cent of the district skilled rate plus 5s. per week.

3. For third six months, 80 per cent of the district skilled rate.

4. For last six months, 90 per cent of the district skilled rate. After this 100 per cent.

The government will contribute toward the wage payments made by the employers 10s. per week for the first six months and 5s. per week for the second six months. This contribution will be paid for a full week even though the man may be working short time, always provided that he present himself for work on the days on which he is required.

If during the first twelve months the employee receives more than 65 per cent of the district rate, the government subsidy will cease from this date.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 5, the next, on June 2.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$3.33	+$4.25	$4.50	$3.23	$3.51	$4.65	$4.35	$5.00	$5.00
Structural rivets, 100 lb	4.85	5.25	5.80	4.88	5.30	6.25	6.40	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.23	3.25	3.75	3.13	3.53½	4.32½	2.35	4.50	4.25
Steel pipe, black, 3½ to 6 in. lap, discount	52%	50.65–5%	45%	58½%	51.9–5%	29%	49.80	45%	5%
Cast-iron pipe, 6 in. and over, ton	63.30	59.22	66.00	64.10	67.80	70.00	85.90	72.00	75.00
Concreting Material:									
Cement without bags, bbl.	2.80 (del.)	3.00	2.60	2.17	2.41	3.10	3.09	3.10	3.44
Gravel, ¾ in., cu.yd	2.50	2.80	−3.50	2.75	2.00	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.62½	3.00	2.75	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	2.15	2.50	2.80	2.75	2.25	3.50	2.25	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	45.00	40.00	50.00	55.00	38.00	47.00	27.00	25.50@28.50	120.00
Lime, finishing, hydrated, ton	21.00	22.50	+27.50	20.00	29.00	32.00	25.40	24.00	30.00
Lime common, lump, 200 lb. bbl.	3.30	1.60	3.00	1.65	2.00	3.20	2.25	2.75	15.00
Common brick, delivered, 1,000	18.40	12.50	16.00	12.00	18.00	14.00	18.00	16.00	18.00
Hollow building tile, 4x12x12, block	Not used	.14	.13	.12	.10	.09	.12½	.11	.19
Hollow partition tile 4x12x12, block	....	.15	.13	.096	.10	.10	.14½	.12	.....
Linseed oil, raw, 5 bbl. lots, gal.	+.80	+.70	+.90	.82	+.91	+.95	+.94	.79	−.70
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	1.00	.50	.50@.63½	.81½	.75	.....
Common labor, non-union, hour	.....	.25	.35@.45	.40@.50	.50	.37½@.50	.50@.55	.40@.45	.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. Steel and crushed stone are quoted f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; steel and pipe at warehouse. No organized common labor in Montreal.

Changes Since Last Week

Business in the construction materials market is extremely light, and pronounced activity is hardly expected before August. Materials are available and prices in many instances are surprisingly reasonable, but the habit of doing nothing presses heavily upon the buying public. In New York cement is at the lowest price commensurate with safe business for the dealer. It can go lower only if cement manufacturers will it. Although there is no change in the official quotations of sand and gravel, sand can be bought, delivered in Manhattan, at $1 per cu.yd.—probably this week only.

On May 12 we called attention to the stiffening of the linseed-oil market, and predicted a rise. On that date oil in New York was available at 70c. per gal., in 5 bbl. lots. Today the price is 80c. This week we announce further advances in Atlanta, Denver, Minneapolis, Dallas and San Francisco. The oil is scarce and seeds are high.

Very little activity is evinced by either the metals or the iron and steel markets. The steel mills accumulate orders until there are sufficient to warrant changing the rolls. Ordinarily, this policy would turn business to the warehouses, but demand is almost nil.

The lumber market is about the same as last week, but Atlanta predicts a stronger tone. Lath in Atlanta is up $2, and dealers reflect greater optimism and money appears to be easier. Our Atlanta correspondent warns that quotations on all materials are by no means absolute and that it is a buyers' market.

As to labor—Chicago predicts settlement of the wage controversy next week. In San Francisco seventeen building crafts are on strike, while the others have been locked out. Builders in the Bay region, outside San Francisco, have notified unions that from May 23 wages would be as decided by the San Francisco arbitration board.

All Minneapolis building crafts are "theoretically" on strike. A meeting between representatives of unions and employers resulted in nothing, because the closed shop, and not the 20 per cent reduction, was made the first issue. The closed shop was refused, and labor men withdrew from the meeting.